PROGRAMMING DOCUMENTS

17 Mar 95

ENERGY ENGINEERING ANALYSIS PROGRAM

ENERGY SURVEY OF ARMY INDUSTRIAL FACILITIES

WESTERN AREA DEMILITARIZATION FACILITY HAWTHORNE ARMY AMMUNITION PLANT HAWTHORNE, NEVADA

VOLUME III

PREPARED FOR

DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

PREPARED BY

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CONTRACT NO. DACA 05-C-92-0155

DEPARTMENT OF THE ARMY
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Table of Contents

1. COMPONENT	FY 1996 MILITARY CONSTRUCTION PROJECT DATA	2. DATE
Army		March 1995

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
Hawthorne Army Ammunition Plant Hawthorne, Nevada	Facility Energy Improvements

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
	80000		1,611.5

9. COST ESTIMATES

Item	U/M	Quantity	Unit Cost	Cost ($000)
Primary Facility				1,312.5
Replace building condensate return systems	LS	—	—	(52.1)
Reduce stream pressure, install new deaerator and repair steam leaks	LS	—	—	(164.4)
Install oxygen trim combustion controls and flue economizer	LS	—	—	(48.9)
Install HVAC system direct digital control (DDC) retrofits	LS	—	—	(600.0)
Install air curtains on roll-up doors	LS	—	—	(30.7)
Install exhaust air heat recovery run-around loop	LS	—	—	(92.1)
Repair melt kettle and separation tank insulation	LS	—	—	(4.8)
Replace existing air compressors with 250HP rotary screw air compressor	LS	—	—	(135.4)
Install variable speed drive retrofits on high pressure water pumps	LS	—	—	(137.0)
Retrofit lighting fixtures	LS	—	—	(47.1)
Supporting Facilities				0
Estimated Contract Cost				1,312.5
Contingency (10%)				131.3
Subtotal				1,443.8
Supervision, Inspection and Overhead (6%)				86.6
Unescalated CWE				1,530.4
Escalation to FY 1996				81.1
Total Request				1,611.5

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Perform the following energy conservation and cost-saving retrofits at the Western Area Demilitarization Facility:

a. Replace steam condensate return systems in Buildings 117-1, 117-3, 117-4, 117-5, 117-6, 117-8 and 117-10.
b. Reduce steam pressure and install new properly-sized deaerating feedwater preheater at Central Boiler Plant 117-2. Repair leaks in distribution piping.
c. Install oxygen trim combustion controls and flue economizer on boiler in Building 117-2.
d. Retrofit existing HVAC system pneumatic controls with DDC systems in Buildings 117-1, 117-3, 117-4, 117-5, 117-6, 177-8, 117-10 and 117-11.
e. Install air curtains on roll-up doors in Buildings 117-5 and 117-6.
f. Install exhaust air heat recovery run-around loops in Buildings 117-5 and 117-6.
g. Repair melt kettle and separation tank insulation in Buildings 117-5 and 117-6.
h. Replace existing compressors with a 250HP, two-stage rotary screw compressor and renovate existing refrigerated air dryers in Building 117-2.
i. Install variable speed drive retrofits on high pressure water pumps in Building 117-6A.
j. Retrofit 369 existing fixtures with energy-efficient units in Buildings 117-1, 117-2, 117-3, 117-4, 117-5, 117-6, 117-6A, 117-7, 117-8, 117-10 and 117-11. Install LED retrofit kits in 81 exit signs in Buildings 117-1, 117-3, 117-4, 117-5, 117-6, 117-8 and 117-10.

DD FORM 1391

11. REQUIREMENT: N.A.	ADEQUATE: N.A.	SUBSTANDARD: N.A.

PROJECT: Implement energy conservation retrofits in 11 buildings at the Western Area Demilitarization Facility. (Current mission.)

REQUIREMENT: This project will contribute toward achieving Department of Defense facility energy goals of a 20-percent reduction in energy use per gross square feet by FY2000 versus FY1985 baseline levels.

This project will save $359,091 annually, resulting in a 4.5-year simple payback period and a savings-to-investment ratio of 2.87. The annual energy savings is 4,003 MBTU (4,223,000 MJ) of electricity and 34,460 MBTU (2,534,000 MJ) of fuel oil. All buildings and retrofit actions will be in active use throughout the amortization period.

CURRENT SITUATION: Unnecessary energy is currently being consumed by space heating and cooling systems, lighting systems, the central air compressor system, high pressure water pumps, and the central steam plant and distribution system.

IMPACT IF NOT PROVIDED: If this project is not accomplished, an annual energy and operations and maintenance expense of $359,091 that could be avoided will be incurred.

ADDITIONAL: This project has been coordinated with the installation physical security plan, and no security improvements are required. This project incorporates recommendations of an Energy Engineering Analysis Program, Energy Survey of Army Industrial Facilities, performed under Contract No. DACA05-92-C-0155.

This installation is not under consideration for realignment or closure.

JOHN G. ZODROW
Lt. Colonel
Commanding

Estimated Construction Start: September 1996	Index: 2032
Estimated Midpoint of Construction: December 1996	Index: 2048
Estimated Construction Completion: March 1997	Index: 2060

DD FORM 1391C

Detailed Justification

1. GENERAL: The project is a significant part of Hawthorne Army Ammunition Plant's effort to achieve a 20-percent reduction in energy consumption by FY2000 versus FY1985 baseline levels.

2. ACCOMMODATIONS NOW IN USE: Not applicable.

3. ANALYSIS OF DEFICIENCY: Present system designs within the facilities proposed for retrofits account for an unnecessary annual energy and operations and maintenance expense of $359,091 that could be avoided.

4. CONSIDERATION OF ALTERNATIVES: The retrofits included in this project represent all of the economically justified actions potential energy conservation opportunities (ECO's) evaluated in the Energy Survey of Army Industrial Facilities that comply with ECIP criteria.

5. CRITERIA FOR PROPOSED CONSTRUCTION: Design and construction will be in accordance with criteria established in DOD 4270.1-M and TM810-5.

6. PROGRAM FOR RELATED FURNISHINGS AND EQUIPMENT: Not applicable.

7. DISPOSAL OF PRESENT ASSETS: Not applicable.

8. SURVIVAL MEASURES: Not applicable.

9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES: Atmospheric emissions will be reduced because less fuel will be burned as a result of implementation of this project.

10. EVALUATION OF FLOOD HAZARDS AND ENCROACHMENT ON WETLANDS: Not applicable.

11. ECONOMIC JUSTIFICATION: In accordance with Energy Conservation Investment Program (ECIP) Guidance dated 10 January 1994, an economic analysis has been prepared. Life-cycle cost analysis results are summarized as follows:

    - Estimated Construction Cost (including SIOH and design costs) $1,617,000
    - Annual Energy Savings . . . . . 38,463 MBTU (6,757,000 MJ)
    - Total First Year Dollar Savings $359,091
    - Discounted Energy Savings $3,922,040
    - Discounted Nonenergy Savings $722,268
    - Total Net Discounted Savings $4,644,308
    - Savings-to-Investment Ratio 2.87

    Refer to "Detailed Calculations" for backup data.

12. UTILITY AND TELECOMMUNICATIONS SUPPORT: Not applicable.

13. PROTECTION OF HISTORIC PLACES AND ARCHEOLOGICAL SITES: Review procedures have been implemented for this project in accordance with 36 CFR 800. The review has established that there will be no effect.

14. PROJECT DEVELOPMENT BROCHURE: A Project Development Brochure (PDB-1) dated March 1995 has been prepared.

15. ENERGY REQUIREMENTS: Not applicable.

16. PROVISION FOR THE HANDICAPPED: Not applicable.

17. REAL PROPERTY MAINTENANCE ACTIVITY ANALYSIS: Not applicable.

18. COMMERCIAL ACTIVITIES: This project involves replacement or modification of existing systems for energy conservation. Under these conditions, the provisions of AR 5-XX do not apply, and a "new start or expansion" is not required.

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements - Total Project Fiscal Year FY96

Analysis Date: March 1995 Economic Life: 20 Years Preparer: KELLER & GANNON

1. Investment Costs

A. Construction Costs	$1,443,807		
B. SIOH	$ 86,628		
C. Design Cost	$ 86,628		
D. Total Cost (1A + 1B + 1C)	$1,617,064		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$1,617,064

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec. 10 Year	$12.82	331		$4,242	8.58	$36,400
B. Elec. 15 Year	$12.82	661		$8,473	12.02	$101,848
C. Elec. 20 Year	$12.82	3,012		$38,606	15.08	$582,185
D. Dist 10 Year	$6.13	4,779		$29,286	9.62	$281,734
E. Dist 15 Year	$6.13	24,466		$149,934	14.23	$2,133,558
F. Dist 20 Year	$6.13	5,215		$31,961	18.57	$593,511
G.Demand 10 Yr	$102.21	60.8	kW	$6,214	8.58	$53,317
H.Demand 15 Yr	$102.21	44.9	kW	$4,589	12.02	$55,165
I.Demand 20 Yr	$102.21	54.7	kW	$5,592	15.08	$84,322
J. Total		38,463.1		$278,898		$3,922,040
		160.4	kW			

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	10 Years	$42,079		
	15 Years	($4,714)	$33,058	total/year
	20 Years	($4,307)		
(1) Discount Factor (Table A)	10 Years		8.53	
	15 Years		11.94	
	20 Years		14.88	
(2) Discounted Savings/Cost (3A x 3A1)				$238,559

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a. 20 year life	$56,470	0	1.000	$56,470
b. 10 year life	$566,068	0	1.000	$566,068
c. 15 year life	($63,235)	5	0.863	($54,572)
d. 15 year life	($63,235)	10	0.744	($47,047)
e. 15 year life	($57,961)	15	0.642	($37,211)
f. Total	$496,069			$483,709

C Total Non Energy Discounted Savings (3A2 + 3Bf4) $722,269

4. First Year Dollar Savings (2J3 + 3A + (Σ3a-e(1)/Years Economic Life	$359,091	
5. Simple Payback (1G/4):	4.50	Years
6. Total Net Discounted Savings (2J5 + 3C):	$4,644,308	
7. Savings to Investment Ratio (SIR) 6/1G:	2.87	

Summary of DD 1391 Energy-Saving Project Elements

Description of Energy Conservation Opportunity	Energy Savings					O & M Savings		Total Savings		Retrofit	Economic Analysis	
	Electric kWH/Yr	Demand kW	Fuel Oil Million BTU/Yr	Energy $/Year	Energy LCC$	Savings $/Year	Savings LCC$	Annual $/Year	Life Cycle LCC$	Invest-ment $	SIR	Payback Years
Central Steam Plant and Distribution System Energy Conservation Opportunities												
Replace Building Condensate Return Systems	0	0.0	1,100	$6,743	$95,957	$0	$0	$6,743	$95,957	$64,200	1.49	9.52
Reduce Steam Pressure, Install New Deaerator, and Repair Steam Leaks	0	0.0	21,218	$130,030	$1,850,332	($2,714)	($32,402)	$115,725	$1,687,577	$202,624	8.33	1.75
Install Oxygen Trim Combustion Controls & Flue Economizer	(8,009)	(0.91)	1,435	$8,348	$119,770	($2,501)	($29,856)	$5,847	$89,914	$60,280	1.49	10.31
Subtotal: Central Steam Plant Energy Conservation Opportunities	**(8,009)**	**(0.91)**	**23,753**	**$145,121**	**$2,066,059**	**($5,214)**	**($62,258)**	**$128,315**	**$1,873,447**	**$327,104**	**5.73**	**2.55**
Building Envelope, HVAC System Control and Heat Recovery Energy Conservation Opportunities												
Bldgs 117-1,3,4,5,6,8,10&11 HVAC System: Install DDC Controls Retrofits	96,962	60.8	4,779	$39,743	$371,451	$42,079	$358,934	$138,429	$1,296,453	$739,286	1.75	5.34
Bldgs 117-5 & 117-6: Install Air Curtains on Roll-Up Doors	(27,798)	(4.95)	1,218	$5,744	$112,676	($42)	($619)	$5,702	$112,057	$37,777	2.97	6.62
Bldg 117-5 & 117-6: Install Exhaust Air Heat Recovery Run-Around Loop	3,763	(0.28)	3,997	$24,631	$456,924	($2,032)	($30,234)	$22,599	$426,690	$113,461	3.76	5.02
Subtotal: Building HVAC System and Heat Recovery ECOs	**72,927**	**55.6**	**9,994**	**$70,118**	**$941,051**	**$40,006**	**$328,081**	**$166,730**	**$1,835,200**	**$890,524**	**2.06**	**5.34**
Process Equipment Insulation Energy Conservation Opportunities												
Repair Building 117-5 & 6 Melt Kettle and Separation Tank Insulation	0	0.00	713	$4,368	$62,164	$0	$0	$3,665	$53,687	$5,907	9.09	1.61
Central Air Compressor System Energy Conservation Opportunities												
Replace Existing with SSR 2-Stage Rotary Screw; Use Existing Air Dryers	293,959	59.93	0	$18,987	$286,329	($2,234)	($33,240)	$19,577	$309,560	$166,795	1.86	8.52
High Pressure Water Pump, Steamout Building Annex 117-6A Energy Conservation Opportunities												
Install Variable Speed Drive Retrofits on High Pressure Water Pumps	612,442	0.00	0	$26,796	$404,089	$0	$0	$26,796	$404,089	$168,767	2.39	6.30

Summary of DD 1391 Energy-Saving Project Elements

Description of Energy Conservation Opportunity	Energy Savings					O & M Savings		Total Savings		Retrofit	Economic Analysis	
	Electric kWH/Yr	Demand kW	Fuel Oil Million BTU/Yr	Energy $/Year	Energy LCC$	Savings $/Year	Savings LCC$	Annual $/Year	Life Cycle LCC$	Invest-ment $	SIR	Payback Years
Lighting Fixture and Lighting Control Energy Conservation Opportunities												
Lighting Fixture Delamping Retrofits												
LD-1: 2-Lamp F40T12 to 1-Lamp F32T8 with Electronic Ballast	879	0.22	0	$61	$732	$7	$82	$68	$815	$302	2.69	4.46
LD-2: 4-Lamp F40T12 to 2-Lamp F32T8 with Electronic Ballast	22,109	6.33	0	$1,614	$19,400	$196	$2,344	$1,810	$21,745	$5,268	4.13	2.91
Lighting Fixture Retrofits												
LF-1: Retrofit LED Lamp Kit in Existing Exit Lights	12,879	1.47	0	$714	$8,584	($57)	($676)	$658	$7,908	$6,037	1.31	9.18
LF4B: Delamp 4-Lamp F40T12s to 2xF32T8s, Reflector, Electronic Ballast	54,275	13.10	0	$3,713	$44,635	$371	$4,434	$4,085	$49,069	$9,925	4.94	2.43
LF-5: Replace 100W Lamp & Base with DTT-26W Compact Fluorescent	1,366	0.39	0	$100	$1,197	$63	$756	$163	$1,953	$309	6.33	1.90
LF-6: Replace 150W Lamp & Base with DTT-26W Compact Fluorescent	215	0.35	0	$45	$537	$6	$67	$50	$604	$154	3.91	3.07
LF-7: Retrofit Exterior 175W MV Fixture with 50W HPS Lamp & Ballasts	71,129	16.28	0	$4,776	$57,413	($261)	($3,116)	$4,515	$54,297	$24,991	2.17	5.53
LF-8: Retrofit Explosion Proof 400W MH with 250W HPS Lamps & Ballasts	38,818	7.68	0	$2,483	$29,850	$175	$2,084	$2,658	$31,934	$10,980	2.91	4.13
Subtotal, Recommended Lighting Energy Conservation Opportunities	**201,669**	**45.82**	**0**	**$13,507**	**$162,349**	**$501**	**$5,976**	**$14,007**	**$168,325**	**$57,967**	**2.90**	**4.14**
Total Recommended ECOs	**1,172,989**	**160**	**34,460**	**278,898**	**3,922,040**	**33,058**	**238,559**	**359,091**	**4,644,308**	**1,617,064**	**2.87**	**4.50**

Table of Contents

DD Form 1391 Detailed Calculations

Central Steam Plant and Distribution System ECOs - Detailed Calculations

WADF Steam System

Building 117-2 houses the central steam plant serving WADF facilities. The steam plant was originally designed and constructed under requirements for dual fuel firing, one of which was required to be coal. The smallest dual fuel capable boilers available at that time were installed. The three Keeler 50,000 PPH steam boilers do not "turn-down" well (low load efficiencies are much lower than efficiencies at greater loads) and have never been operated after their initial acceptance testing. They have been, and remain, "mothballed".

When the WADF was placed into operation several years ago, a packaged fire tube boiler was installed in the boiler plant to provide steam service only to WADF facilities at high efficiency. The boiler is located in the service bay at the North-West corner of the building and utilizes the deaerating Feedwater Heater and other ancillary equipment installed to serve the three 50,000 PPH coal fired steam boilers.

Boiler	Cleaver-Brooks	Input (DF-2):	16,738	MBH
	Model: CB 100-400		119.5	Gallons per Hour No. 2 Fuel Oil
	S/N: L-89956	Blower Motor:	15	HP
	Rated: 150 psi	Air Compressor:	5	HP
	Dated: 8/23/91	Primary Safety Controls:	4D	

Deaerating Feedwater Heater

Cleaver-Brooks
Model: 8M-100 S/N: D3-1935
Capacity: 100,000 PPH
Shipped: 7/23/76

Steam is distributed via surface and underground piping to WADF buildings. The system is shown schematically on Figure 1.

Recommendations for Central Steam Plant and Distribution System Energy Conservation

During field investigations of the steam plant and distribution systems, several significant deficiencies were noted.

Deaerating Feed Water Heater is sized for the three large coal fired boilers. Consider replacing this unit with one properly sized for the smaller packaged steam boiler system.

Steam Pressure is higher than is needed. Building steam usage is for HVAC and WADF process use. The HVAC utilization pressure is about 40 psig; WADF processes require only 15 psig steam. Consider reducing steam pressure to the minimum needed to serve requirements.

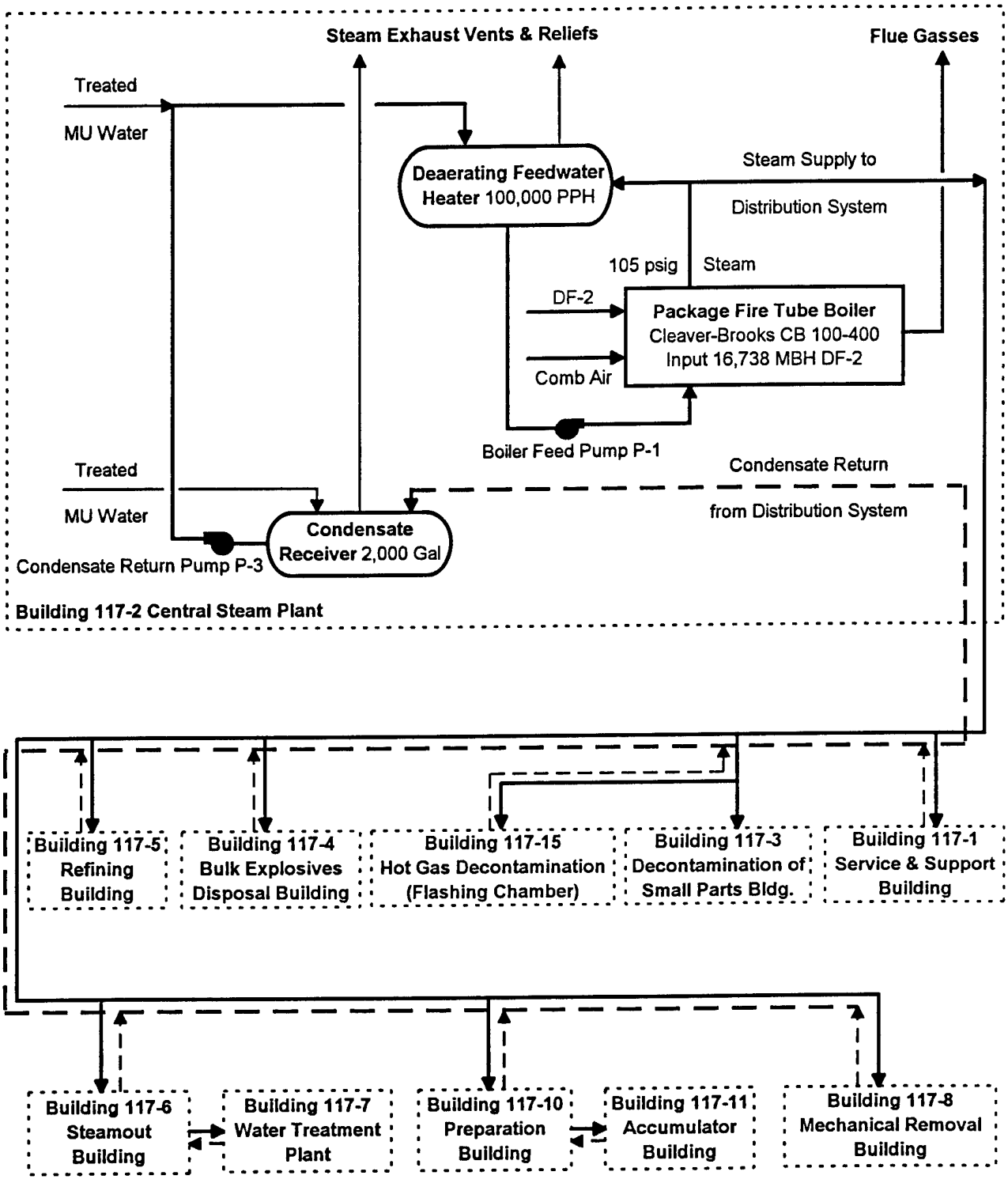
Flue temperature was measured at about 370°F; consider installing a stack economizer system.

Boiler combustion efficiency was measured at only 78%, much lower than is achievable with this type boiler. Consider installation of Automatic Oxygen Trim Combustion Controls or conduct more frequent boiler tune-ups.

Almost no condensate is returned from WADF buildings. Process uses of steam require contact with explosives for most uses, thus, no condensate is returned from them.

HVAC steam usage should provide significant condensate return. Field investigation of condensate return systems in WADF building mechanical room steam pits found only a single system operating; almost every condensate receiver-pump set was found to be non-functional. Consider repairing and/or replacing all the condensate receiver-pump sets.

Figure 1. WADF Steam Distribution System Schematic Diagram



Central Steam Plant Efficiency (Building 117-2)

Combustion Efficiency measured using a Beckett C5 Oxygen Analyzer; readings:

11.65% Oxygen 375 °F = 78.0% Combustion Efficiency for No. 2 Fuel Oil

In-Plant Losses:

Radiation Losses	-2.50%
Shutdown Losses	-2.00%
Insulation (Convection) Losses	-2.00%
General Condition Losses	-2.00%

Leakage: Several significant steam leaks were observed on exterior steam distribution piping. Most steam traps in non-process applications are not functioning well, and many leaks were observed in building mechanical room steam systems. In addition, only one of the condensate receiver / pump installations is working properly.

Leakage is quantified by observing make-up water and fuel consumption records for the past several months of operations. No processing takes place on most Sundays. The steam boilers are kept on line since they will be needed again in less than 24 hours following the last Saturday shift. Fuel and make-up water useage are shown on Figure 2 and on Table 1.

Sunday Make-up Water and Fuel consumption gallons per day from Table 1 are:

Date/Time	Total Water	Fuel	
~~5-Jun~~	~~130~~	~~647~~	Boiler Plant Shut Down
~~12-Jun~~	~~5,800~~	~~778~~	MU water too high for no processing, heating needed?
19-Jun	4,680	490	
26-Jun	4,030	631	
~~3-Jul~~	~~0~~	~~154~~	Boiler Plant Shut Down
10-Jul	3,960	729	
17-Jul	3,450	639	
24-Jul	4,080	676	
31-Jul	4,320	238	
7-Aug	4,190	559	
~~14-Aug~~	~~5,230~~	~~652~~	MU water too high for no processing, heating needed?
~~21-Aug~~	~~5,240~~	~~650~~	MU water too high for no processing, heating needed?
~~28-Aug~~	~~6,570~~	~~826~~	MU water too high for no processing, heating needed?
~~4-Sep~~	~~2,350~~	~~440~~	MU water too high for no processing, heating needed?
~~11-Sep~~	~~8,700~~	~~1,035~~	MU water too high for no processing, heating needed?

Average Make-up Water:	4,101	gallons/day
Average Fuel Usage:	566	gallons/day

4,101 gallons water is lost daily due to leaks (nic process steam consumption).
6,581 gallons water is consumed daily, on the average, thus, the above loss represents 62.3% of overall water makeup needs. The remainder, about 2,480 gallons per day (average) represents steam consumed for demilitarization processes and for building HVAC uses. Process steam usage consumes the steam without condensate return. Condensate return systems serving building HVAC systems are inoperative. Thus, no condensate is returned to the steam plant. Since the above data is from the non-heating season, the 2,480 gallons per day of makeup water not attributed to leaks is assumed to be process steam consumption.

Efficiency: Based on raw water at 50°F and condensate return normally at 200°F, leakage represents a loss of about 150 BTU/lb. Heat required to produce 105 psig saturated steam from condensate at atmospheric pressure and 200°F is about 985 BTU/lb. Thus loss of the above percentage of condensate represents a boiler plant efficiency loss of: 9.49% .

Overall Steam Plant Efficiency =

60.0%	(up to individual building mechanical rooms)
5.0%	additional losses assumed in each building mechanical room
55.0%	Used for HVAC system modification evaluations.

Figure 2.
Boiler Plant Make-Up Water & Fuel Use (Gallons)
June to September 1994

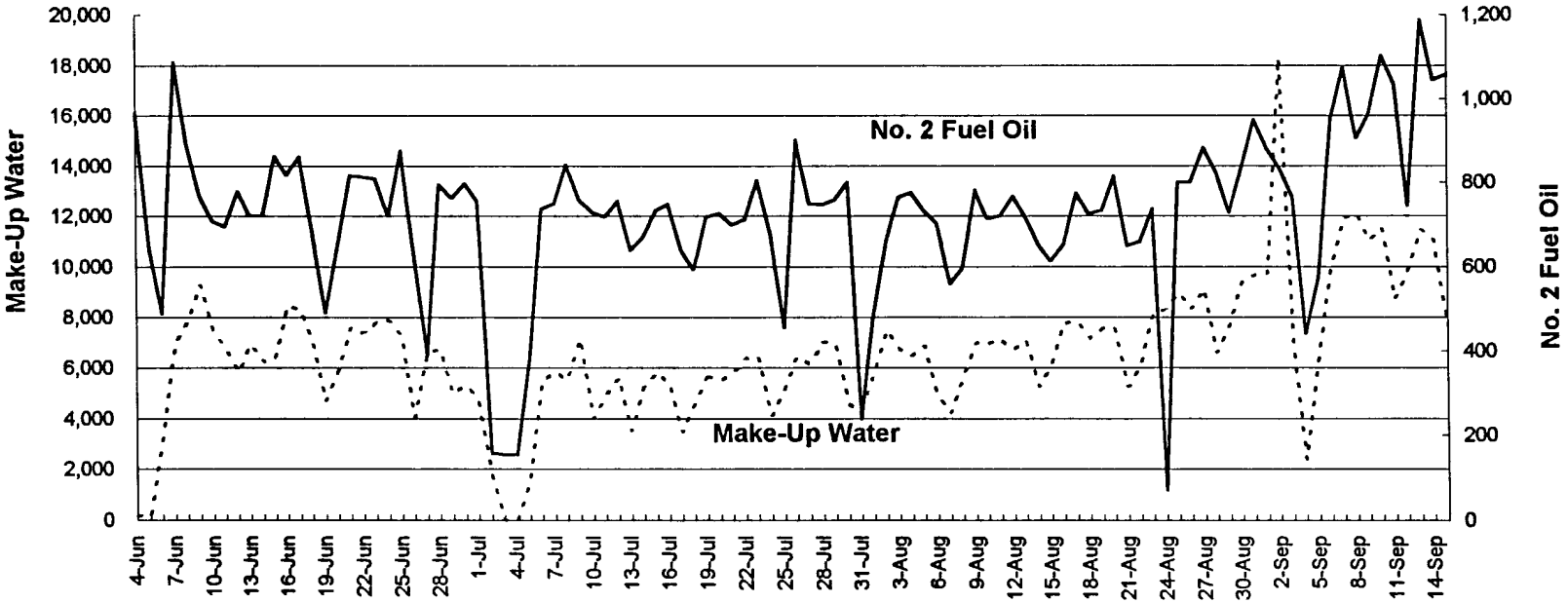


Table 1. Building 117-2 Boiler Plant Make-Up Water Usage and Fuel Consumption

Date/Time	0400	0530	0700	1230	1630	2000	Total Water	Fuel	Day
4-Jun	30	40	40	30	40	10	190	966	Sat
5-Jun	20	30	10	30	20	20	130	647	Sun
6-Jun	10	30	20	30	1,640	1,360	3,090	488	Mon
7-Jun	1,160	1,620	1,020	1,410	1,050	740	7,000	1,086	Tue
8-Jun	1,210	1,230	1,190	1,740	940	1,490	7,800	892	Wed
9-Jun	1,430	1,220	1,890	2,150	850	1,760	9,300	767	Thur
10-Jun	1,200	1,420	1,280	1,450	620	1,420	7,390	708	Fri
11-Jun	990	1,370	1,170	1,380	680	1,140	6,730	695	Sat
12-Jun	1,140	1,170	790	1,180	680	840	5,800	778	Sun
13-Jun	570	1,190	1,250	880	1,390	1,640	6,920	721	Mon
14-Jun	850	1,130	1,030	2,080	630	530	6,250	720	Tue
15-Jun	1,140	1,400	120	1,200	1,360	1,200	6,420	863	Wed
16-Jun	1,320	1,350	1,100	2,180	1,120	1,390	8,460	818	Thur
17-Jun	1,420	1,410	1,760	950	980	1,790	8,310	862	Fri
18-Jun	1,130	860	1,490	1,490	590	1,480	7,040	692	Sat
19-Jun	610	1,300	610	1,100	270	790	4,680	490	Sun
20-Jun	790	940	970	760	840	1,590	5,890	654	Mon
21-Jun	660	1,560	2,600	2,010	750	-	7,580	816	Tue
22-Jun	1,460	1,150	1,280	870	1,210	1,400	7,370	813	Wed
23-Jun	1,020	1,600	2,440	1,110	1,610	-	7,780	809	Thur
24-Jun	1,080	1,410	1,210	1,170	1,270	1,740	7,880	721	Fri
25-Jun	1,090	1,440	2,070	590	1,430	620	7,240	876	Sat
26-Jun	980	-	-	-	2,510	540	4,030	631	Sun
27-Jun	1,150	510	1,410	810	1,610	1,120	6,610	390	Mon
28-Jun	1,250	1,360	990	1,060	1,140	940	6,740	795	Tue
29-Jun	940	900	670	1,020	590	870	4,990	763	Wed
30-Jun	930	860	1,030	880	630	990	5,320	797	Thur
1-Jul	1,010	950	670	770	570	720	4,690	755	Fri
2-Jul	510	580	480	190	-	-	1,760	158	Sat
3-Jul	-	-	-	-	-	-	0	154	Sun
4-Jul	-	-	-	-	-	-	0	154	Mon
5-Jul	-	-	-	-	400	1,150	1,550	386	Tue
6-Jul	900.00	810	1,200	680	700	1,190	5,480	736	Wed
7-Jul	810	1,140	880	920	980	1,120	5,850	749	Thur
8-Jul	950	1,350	840	640	770	980	5,530	843	Fri
9-Jul	990	1,060	640	3,430	400	630	7,150	758	Sat
10-Jul	890	900	350	810	410	600	3,960	729	Sun
11-Jul	480	640	760	890	1,030	1,130	4,930	718	Mon
12-Jul	650	1,370	1,100	590	1,000	900	5,610	756	Tue
13-Jul	410	600	690	300	560	920	3,480	639	Wed
14-Jul	830	920	780	880	770	1,070	5,250	670	Thur
15-Jul	900	1,050	740	990	880	1,240	5,800	733	Fri
16-Jul	610	1,310	870	990	690	990	5,460	748	Sat
17-Jul	290	1,080	300	670	430	680	3,450	639	Sun
18-Jul	310	890	550	790	960	1,030	4,530	593	Mon
19-Jul	640	1,160	870	970	870	1,150	5,660	717	Tue
20-Jul	730	1,320	810	830	740	1,080	5,510	726	Wed
21-Jul	870	1,110	890	930	840	1,120	5,760	699	Thur
22-Jul	860	1,150	710	1,080	1,060	1,510	6,370	712	Fri
23-Jul	510	1,170	1,250	1,140	750	1,630	6,450	805	Sat
24-Jul	500	900	590	990	330	770	4,080	676	Sun
25-Jul	680	260	850	1,070	1,150	1,150	5,160	455	Mon

Table 1. Building 117-2 Boiler Plant Make-Up Water Usage and Fuel Consumption

Date/Time	0400	0530	0700	1230	1630	2000	Total Water	Fuel	Day
26-Jul	960	1,250	750	1,230	1,090	1,170	6,450	901	Tue
27-Jul	880	1,350	840	950	1,090	1,070	6,180	749	Wed
28-Jul	860	1,760	880	1,110	1,020	1,380	7,010	747	Thur
29-Jul	890	1,550	1,240	1,160	990	1,090	6,920	759	Fri
30-Jul	610	960	820	940	490	760	4,580	800	Sat
31-Jul	600	1,040	420	900	610	750	4,320	238	Sun
1-Aug	680	890	920	1,080	1,010	1,190	5,770	493	Mon
2-Aug	970	1,750	920	1,070	1,100	1,660	7,470	662	Tue
3-Aug	790	1,380	1,180	930	1,200	1,260	6,740	764	Wed
4-Aug	1,250	1,350	1,330	-	1,030	1,520	6,480	776	Thur
5-Aug	930	1,380	990	1,270	1,430	870	6,870	734	Fri
6-Aug	650	1,210	720	1,000	360	950	4,890	703	Sat
7-Aug	650	1,030	360	840	590	720	4,190	559	Sun
8-Aug	580	930	670	1,100	1,000	1,310	5,590	596	Mon
9-Aug	720	1,450	1,330	1,150	1,010	1,320	6,980	781	Tue
10-Aug	890	1,310	940	1,260	1,000	1,550	6,950	713	Wed
11-Aug	1,070	1,430	1,200	1,500	570	1,350	7,120	720	Thur
12-Aug	1,210	1,570	190	1,320	1,070	1,370	6,730	767	Fri
13-Aug	1,100	1,480	1,040	1,240	920	1,280	7,060	718	Sat
14-Aug	790	1,270	550	1,040	680	900	5,230	652	Sun
15-Aug	470	1,320	770	1,340	1,200	1,000	6,100	613	Mon
16-Aug	1,130	1,280	1,070	1,530	1,210	1,530	7,750	652	Tue
17-Aug	970	1,640	1,170	1,150	1,590	1,310	7,830	775	Wed
18-Aug	910	1,310	1,050	1,410	1,090	1,390	7,160	725	Thur
19-Aug	1,070	1,290	1,280	1,270	1,150	1,500	7,560	733	Fri
20-Aug	1,160	2,880	1,260	1,100	-	1,160	7,560	815	Sat
21-Aug	-	-	2,390	1,300	830	720	5,240	650	Sun
22-Aug	790	1,040	980	850	1,290	1,170	6,120	660	Mon
23-Aug	1,250	1,500	1,190	1,470	1,070	1,620	8,100	737	Tue
24-Aug	1,200	1,870	1,200	1,350	1,420	1,260	8,300	71	Wed
25-Aug	1,270	1,460	1,000	1,790	1,190	2,240	8,950	800	Thur
26-Aug	680	1,570	1,180	1,630	1,330	1,910	8,300	802	Fri
27-Aug	1,150	1,770	1,220	1,560	1,020	2,390	9,110	883	Sat
28-Aug	1,210	1,430	1,020	1,280	670	960	6,570	826	Sun
29-Aug	1,020	1,140	1,310	1,500	1,280	1,430	7,680	728	Mon
30-Aug	1,470	1,730	1,340	1,640	1,110	2,070	9,360	832	Tue
31-Aug	1,160	1,660	1,940	1,650	1,120	2,140	9,670	950	Wed
1-Sep	870	1,870	1,980	1,590	910	2,480	9,700	880	Thur
2-Sep	9,530	420	740	2,160	3,000	2,440	18,290	835	Fri
3-Sep	2,560	550	850	980	2,070	-	7,010	764	Sat
4-Sep	370	360	340	520	390	370	2,350	440	Sun
5-Sep	380	710	890	1,700	1,150	1,610	6,440	577	Mon
6-Sep	260	2,110	1,980	2,050	1,530	2,070	10,000	951	Tue
7-Sep	1,620	2,390	2,470	1,800	1,700	1,930	11,910	1,077	Wed
8-Sep	2,060	2,320	1,780	2,160	2,230	1,540	12,090	906	Thur
9-Sep	2,030	2,120	1,560	2,230	1,450	1,620	11,010	963	Fri
10-Sep	1,810	2,520	1,840	2,410	1,150	1,800	11,530	1,102	Sat
11-Sep	1,410	1,900	2,070	890	890	1,540	8,700	1,035	Sun
12-Sep	1,140	1,560	1,555	2,390	1,700	1,500	9,845	745	Mon
13-Sep	2,000	2,170	2,210	1,550	1,410	2,130	11,470	1,187	Tue
14-Sep	1,490	2,120	2,320	1,670	1,510	1,960	11,070	1,044	Wed
15-Sep	1,800	2,420	1,730	1,760	-	-	7,710	1,057	Thur

Table 2. Summary of Central Steam Plant and Distribution System Energy Conservation Opportunities

Description of Energy Conservation Opportunity	Energy Savings		Energy Cost Savings				O & M Savings		Total Savings	
	Electric kWH/Yr	Fuel Oil Million BTU/Yr	Electric $/Year	Fuel Oil $/Year	Energy $/Year	Energy LCC$	Savings $/Year	Savings LCC$	Annual $/Year	Life Cycle LCC$
Central Steam Plant and Distribution System Energy Conservation Opportunities										
Replace Building Condensate Return Systems	0	1,100	$0	$6,743	$6,743	$95,957	$0	$0	$6,743	$95,957
Reduce Steam Pressure, Install New Deaerator, and Repair Steam Leaks	0	21,218	$0	$130,030	$130,030	$1,850,332	($2,714)	($32,402)	$115,725	$1,687,577
	Note: This ECO includes equipment replacement costs at 5 and 10 years at present value of:									$57,961
Install Oxygen Trim Combustion Controls & Flue Economizer	(8,009) (0.91)kW	1,435	($444)	$8,792	$8,348	$119,770	($2,501)	($29,856)	$5,847	$89,914
Summary Central Steam Plant Energy Conservation Opportunities	(8,009)	23,753	($444)	$145,565	$145,121	$2,066,059	($5,214)	($62,258)	$128,315	$1,873,447

Description of Energy Conservation Opportunity	Retrofit Investment $	Economic Analysis SIR	Payback Years
Replace Building Condensate Return Systems	$64,200	1.49	9.52
Reduce Steam Pressure, Install New Deaerator, and Repair Steam Leaks	$202,624	8.33	1.75
Install Oxygen Trim Combustion Controls & Flue Economizer	$60,280	1.49	10.31
Summary Central Steam Plant Energy Conservation Opportunities	$327,104	5.73	2.55

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Replace Condensate Receiver / Return Pump Sets in WADF Buildings, Reduce Steam Pressure, Install New Deaerator, and Repair Steam Leaks, & Install Flue Economizer and Oxygen Trim Combustion Controls
Analysis Date: March 1995 Economic Life: 15 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$292,057		
B. SIOH	$ 17,523		
C. Design Cost	$ 17,523		
D. Total Cost (1A + 1B + 1C)	$ 327,104		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$327,104

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	(27.33)		($350)	12.02	($4,212)
B. Dist	$6.13	23,753		$145,565	14.23	$2,071,394
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	(0.9)	kW	($93)	12.02	($1,123)
F. Total		23,725		$145,121		$2,066,059

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($5,214)		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			($62,258)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	($57,961)	5	0.863	($50,020)
b.	($57,961)	10	0.744	($43,123)
c.	($57,961)	15	0.642	($37,211)
d. Total	($173,882)			($130,354)

C Total Non Energy Discounted Savings (3A2 + 3Bd4) ($192,611)

4. First Year Dollar Savings (2F3 + 3A + (3Bd1/Years Economic Lif	$128,315	
5. Simple Payback (1G/4):	2.55	Years
6. Total Net Discounted Savings (2F5 + 3C):	$1,873,447	
7. Savings to Investment Ratio (SIR) 6/1G:	5.73	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Replace Condensate Receiver / Return Pump Sets in WADF Buildings
Analysis Date: March 1995 Economic Life: 15 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$57,322		
B. SIOH	$ 3,439		
C. Design Cost	$ 3,439		
D. Total Cost (1A+1B+1C)	$ 64,200		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$64,200

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)	Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	0.0	$0	12.02	$0
B. Dist	$6.13	1,100	$6,743	14.23	$95,957
C. LPG	-	-			
D. Other	-	-			
E. Elec Demand	$102.21		$0		
F. Total		1,100	$6,743		$95,957

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.		0	1.00	$0
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4)	$0	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$6,743	
5. Simple Payback (1G/4):	9.52	Years
6. Total Net Discounted Savings (2F5+3C):	$95,957	
7. Savings to Investment Ratio (SIR) 6/1G:	1.49	

WADF Building HVAC System Condensate Return System Replacement

HVAC energy usage is estimated for selected WADF buildings in Appendix D where HVAC control system, building envelope and heat recovery energy saving projects are evaluated. Results of these simulations are:

Building Number	Description	Electric kWH/Yr	Fuel Oil k BTU/Yr	Includes consideration of the following ECOs with SIRs > 1
117-1	Services & Supply	91,447	639,767	DDC Controls Retrofit
117-2	Central Heating Plant	NA	NA	NA
117-3	Decontamination of Small Parts	104,029	1,060,060	DDC Controls Retrofit
117-4	Bulk Explosives Disposal	69,400	783,096	DDC Controls Retrofit
117-5	Refining Building	90,697	868,975	DDC Controls, Ht Recovers & Air Curtains
117-6	Steamout Building	152,601	1,470,778	DDC Controls, Ht Recovers & Air Curtains
117-6A	Water Booster Pump Building	NA	NA	NA
117-7	Process Water Treatment Building	NA	NA	NA
117-8	Mechanical Removal Building	60,908	609,765	DDC Controls Retrofit
117-10	Preparation Building	78,614	1,316,319	DDC Controls Retrofit
117-11	Accumulator Building	Included with 117-10 results		
117-15	Flashing Chamber	NA	NA	NA
Total Estimated HVAC Energy Usage		**647,695**	**6,748,760**	**with successful HVAC ECOs**

HVAC Fuel Oil consumption includes losses from condensate that could have been returned to the central steam plant, but is not because of inoperative equipment.

The plant efficiency used to determine the above heating energy use: 55%
Thus, the heating load, or steam energy consumption is: 3,712 Million BTU/Year.

Steam is distributed at 105 psig, is reduced through pressure regulating valves to 40 psig and is then condensed in heat exchangers to heat a water-ethylene glycol mixture for circulation through heating coils and convectors. Enthalpies of the steam, condensate and raw water are as follows:

	Total enthalpy	h_{f-g}
Saturated steam, 105 psig =	1,190 BTU/Lb	878
Saturated Steam, 40 psig =	1,176 BTU/Lb	920
Liquid, 200°F =	168 BTU/Lb	
Liquid, 50°F =	18 BTU/Lb	

Steam generated to satisfy the HVAC heating loads is: 4,034,585 Pounds per Year.
Heat lost from condensate <u>not</u> returned is, thus: 605 Million BTU/Year

Equivalent fuel consumption, per existing boiler efficiency: 1,100 Million BTU/Year No. 2 Fuel Oil

Electric usage is assumed to remain the same as existing because existing condensate receiver-pump systems are energized, but are leaking into the steam pit sump. A small amount of additional electric power consumption is expected, however, it is not likely to be significant.

Operations and maintenance expenses are expected to be the same as for the existing system.

CONSTRUCTION COST ESTIMATE	Date Prepared March-95	Sheet 1	of 1

Project	Project No.	Basis for Estimate
ECIP Facility Energy Improvements		
Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada		Code A (no design competed)
Engineer-Architect: Keller & Gannon		

Drawing No.	Estimator	Checked By
Replace Condensate Return Systems	B. I. Horst	R. C. Lennig

Line Item	Quantity		Labor		Material		Total
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Cost
Simplex Condensate Return System, pump, motor, float switch, controls, cast iron receiver	14	EA	$609	$8,533	$1,099	$15,379	$23,912
Duplex Condensate Return System, 2 pumps, motors, float switch, alternator assembly, cast iron rcvr	1	EA	$1,219	$1,219	$2,953	$2,953	$4,172
Miscellaneous Piping and Insulation Repairs, per System	15	EA	$609	$9,142	$203	$3,044	$12,186
Subtotal				$18,894		$21,377	$40,271
Nevada Sales Tax	3.75%	%		-		$802	$802
Subtotal							$41,073
Contractor OH & Profit	25.0%	%					$10,268
Subtotal							$51,341
Bond	1.5%	%					$770
Subtotal							$52,111
Estimating Contingency	10.0%	%					$5,211
Total Probable Construction Cost							**$57,322**

Building Number	Description	Simplex	Duplex
117-1	Services & Supply	2	-
117-2	Central Heating Plant	-	-
117-3	Decontamination of Small Parts	2	-
117-4	Bulk Explosives Disposal	2	-
117-5	Refining Building	-	1
117-6	Steamout Building	4	-
117-6A	Water Booster Pump Building	-	-
117-7	Process Water Treatment Building	-	-
117-8	Mechanical Removal Building	2	-
117-10	Preparation Building	2	-
117-11	Accumulator Building	-	-
117-15	Flashing Chamber	-	-
	Totals	**14**	**1**

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Reduce Steam Pressure, Install New Deaerator, and Repair Steam Leaks
Analysis Date: March 1995 Economic Life: 15 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$180,914		
B. SIOH	$ 10,855		
C. Design Cost	$ 10,855		
D. Total Cost (1A+1B+1C)	$ 202,624		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$202,624

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)	Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	0.0	$0	12.02	$0
B. Dist	$6.13	21,218	$130,030	14.23	$1,850,332
C. LPG	-	-			
D. Other	-	-			
E. Elec Demand	$102.21				
F. Total		21,218	$130,030		$1,850,332

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($2,714)		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			($32,402)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	($57,961)	5	0.863	($50,020)
b.	($57,961)	10	0.744	($43,123)
c.	($57,961)	15	0.642	($37,211)
d. Total	($173,882)			($130,354)

C Total Non Energy Discounted Savings (3A2+3Bd4) ($162,755)

4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$115,725	
5. Simple Payback (1G/4):	1.75	Years
6. Total Net Discounted Savings (2F5+3C):	$1,687,577	
7. Savings to Investment Ratio (SIR) 6/1G:	8.33	

Reduce Central Boiler Plant Steam Pressure & Install Properly-Sized Deaerator (Including Distribution System Leak Repairs)

Deaerating Feedwater Heater

The deaerating feed water heater now in use is sized for the three large coal fired boilers. Sodium sulfite is added to scavenge oxygen from boiler feed water.

168 Lbs Na_2SO_3 was added to boiler makeup water during the period:
1-Feb-94 through 1-Sep-94 212 days, with 6,645 gallons average makeup / day;
1,408,719 gallons total in above period, or 9.1 ppm by weight SO_3 overall.

A residual of 20 ppm SO_3, as stated in the DZB letter of 5 October 1994, even without any dissolved O_2 needs 371 Lbs Na_2SO_3 during the period.

Other water treatment chemicals used for the boiler feedwater treatment during this period include:

22.65 Gallons Phosphorus
20.50 Gallons Lye
94.50 Gallons Polymer

Raw water common ion analyses indicate hardness of 152 ppm (analysis of building 117-1 cold water on 12 March 1992).

In addition, the existing deaerating feedwater heater is far oversized for the packaged boiler:

The packaged boiler can generate about 13,400 PPH of steam.

The deaerating feedwater heater is sized for 100,000 PPH of throughput.

Based on sizing alone, the package steam boiler can service either the deaerating feedwater heater or the steam load, but not both.

Conclusion: Chemicals usage for oxygen control in the boiler feed water (BFW) is insufficient.
Chemicals usage for softening BFW is insufficient.
Once through system (with almost 100% make-up) requires better water treatment

Recommendation: Clean scale from boiler water side immediately. Scaling is most likely already causing operating problems and may endanger the boiler's future operation.

Reduce Operating Steam Pressure

The operating steam pressure is higher than is needed. Building steam usage is for HVAC and WADF process use. The HVAC utilization pressure is about 40 psig; WADF processes require only 15 psig steam. Reduce the steam pressure to the minimum required to serve these requirements.

During field investigations, the steam pressure at Building 117-8, the building farthest from the central steam plant, was observed to be about 80 psig (based on existing pressure gauge). Assuming that this pressure is accurate, the system provides for about 25 psig of pressure drop from the steam plant to the farthest point of use.

		Operating Pressure Requirements			Reduced System
Operating Period	Months	HVAC	Process	Maximum	Operating Pressure
Winter Heating Season	Oct - May	38 psig	15 psig	38 psig	63 psig
Summer Non-heating Season	Jun - Sep	NA	15 psig	15 psig	40 psig

Energy savings calculations due to reduced operating pressures are based on the following:

	Total enthalpy of steam		h_{f-g}
Saturated steam, 105 psig =	1,190	BTU/Lb	878
Saturated steam, 63 psig =	1,183	BTU/Lb	902
Saturated Steam, 40 psig =	1,176	BTU/Lb	920
Liquid, 200°F =	168	BTU/Lb	
Liquid, 50°F =	18	BTU/Lb	

Existing Energy Consumption, including: Recommended HVAC Control, Exhaust Heat Recovery and Air Curtain Retrofits and Repairs to HVAC Steam Condensate Return Systems

Steam Plant Efficiency (Baseline):	55.0%	
HVAC System Requirements		
HVAC Steam LOAD, with HVAC ECOs Implemented:	3,712	Million BTU/Year
Steam Needed at 40 psig to satisfy load:	4,034,585	Pounds Steam/Year
Heat required from boiler with condensate system repaired, 105 psig:	**4,123**	**Million BTU/Year**
Process Steam Requirements		
Steam requirements based on Make-up Water Records:	20,705	Lbs/Process-Day
Process Days per Year assuming Sundays-only off:	313	Process-Days/Year
Process Steam Requirements:	6,480,509	Pounds/Year
Heat required at present operating steam pressure (105 psig):	**7,595**	**Million BTU/Year**
Steam Leaks in Distribution System		
Steam Loss due to leaks in distribution piping:	34,247	Pounds/Day
Days per year of boiler operations (including non-processing days)	365	Days/Year
Steam Losses:	12,500,129	Pounds/Year
Heat required at present operating steam pressure (105 psig):	**14,650**	**Million BTU/Year**
Total Steam Heat Required	26,369	Million BTU/Year
Equivalent No. 2 Fuel Oil Consumption (corrected for leakage):	**37,941**	**Million BTU/Year**

Future Energy Consumption, including: Repairs of Steam Distribution System Leaks, Installation of a Proper-Sized Deaerating Feedwater Heater & Operations at Reduced Steam Pressures

Steam Plant Efficiency with leaks repaired (see Efficiency Calculations):	64.5%	
HVAC System Requirements		
HVAC Steam LOAD, with HVAC ECOs Implemented:	3,712	Million BTU/Year
Steam Needed at 40 psig to satisfy load:	4,034,585	Pounds Steam/Year
Heat required from boiler with condensate system repaired, 63 psig:	**4,095**	**Million BTU/Year**
Process Steam Requirements		
Steam requirements based on Make-up Water Records:	20,705	Lbs/Process-Day
Process Days per Year assuming Sundays-only off:	313	Process-Days/Year
Process Steam Requirements:	6,480,509	Pounds/Year
Heat required at reduced operating pressure (63 psig - Winter):	3,775	Million BTU/Year
Heat required at reduced operating pressure (40 psig - Summers):	3,752	Million BTU/Year
Total Heat required at reduced operating pressures:	**7,527**	**Million BTU/Year**
Steam Leaks in Distribution System		
Steam Loss due to leaks in distribution piping (assumed repaired):	**0**	**Million BTU/Year**
Total Steam Heat Required	11,622	Million BTU/Year
Equivalent No. 2 Fuel Oil Consumption (corrected for leakage):	**16,723**	**Million BTU/Year**

No. 2 Fuel Oil Savings from repairs of leaks, new deaerator and reduced steam operating pressures: **21,218** **Million BTU/Year**

Note: Fuel oil consumption estimated for these repairs and system upgrades is based on operation of WADF facilities two shifts per day, six days per week, year-round. This is the current schedule (Fall 1994), however, it is subject to change depending on the level of activity required.

CONSTRUCTION COST ESTIMATE

Date Prepared: March-95 | Sheet: 1 of 1

Project: ECIP Facility Energy Improvements | Project No.:

Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada

Basis for Estimate: Code A (no design competed)

Engineer-Architect: Keller & Gannon

Drawing No.: Steam Leak Repairs, New Deaerator & Lower Steam Pressures | Estimator: B. I. Horst | Checked By: R. C. Lennig

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Deaerating Feedwater Heater Retrofit							
Deaerating Feedwater Heater for Cleaver Brooks Steam Boiler	1	EA	$15,000	$15,000	$35,000	$35,000	$50,000
Pipe - Deaerating Feedwater Heater: 4-inch Dia Sch 80 Welded Steel	250	LF	$16.51	$4,127	$10.10	$2,526	$6,653
Pipe - Deaerating Feedwater Heater: 2-inch Dia Sch 80 Welded Steel	100	LF	$10.01	$1,001	$4.49	$449	$1,450
Steam Pressure Controller & Interface							
Steam Pressure Sensor	1	EA	$67	$67	$873	$873	$940
P/E Relay	1	EA	$55	$55	$130	$130	$185
Auxilliary Contact	1	EA	$50	$50	$350	$350	$700
DDC Control Unit - 16 Point	1	EA	$500	$500	$2,500	$2,500	$3,000
Miscellaneous Steam Distribution Piping Leak Repairs							
Steam Main 14-inch "Spool" on 10-inch line, replace flange & gaskets	1	EA	$271	$271	$150	$150	$421
Steam Control Valve, 4-inch Flanged, Iron Body	2	EA	$122	$122	$1,577	$3,154	$3,276
Replace Ball-Expansion Joints, Steam Piping, 10-inch Steam	10	EA	$125	$1,254	$1,871	$18,711	$19,965
Replace Ball-Expansion Joints, Steam Piping, 6-inch	10	EA	$79	$790	$1,096	$10,959	$11,749
Labor and Materials for steam piping miscellaneous repairs	500	MH	$42.33	$21,165	$14.11	$7,055	$28,220
Subtotal				$44,402		$81,857	$126,560
Nevada Sales Tax	3.75%	%		-		$3,070	$3,070
Subtotal							$129,629
Contractor OH & Profit	25.0%	%					$32,407
Subtotal							$162,037
Bond	1.5%	%					$2,431
Subtotal							$164,467
Estimating Contingency	10.0%	%					$16,447
Total Probable Construction Cost							**$180,914**

For Life Cycle Cost Analysis, assume steam piping leak repairs must be performed every five years. These costs are expensed each five years in the Life Cycle Cost Analysis Summary. **$57,961**

Annual O&M expenses are assumed equal to 1.5% of the construction costs per year: **$2,714** per year.

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Install Flue Economizer and Oxygen Trim Combustion Controls
Analysis Date: March 1995 Economic Life: 15 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$53,821		
B. SIOH	$ 3,229		
C. Design Cost	$ 3,229		
D. Total Cost (1A+1B+1C)	$ 60,280		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$60,280

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	(27.3)		($350)	12.02	($4,212)
B. Dist	$6.13	1,435		$8,792	14.23	$125,105
C. LPG	-	-				
D. Other	-					
E. Elec Demand	$102.21	(0.9)	kW	($93)	12.02	($1,123)
F. Total		1,407		$8,348		$119,770

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($2,501)		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			($29,856)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.				
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4)	($29,856)	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$5,847	
5. Simple Payback (1G/4):	10.31	Years
6. Total Net Discounted Savings (2F5+3C):	$89,914	
7. Savings to Investment Ratio (SIR) 6/1G:	1.49	

Install Oxygen Trim Combustion Controls and Boiler Flue Economizer on Fire-Tube Boiler to Preheat Boiler Feedwater

Based on field measurement of combustion efficiency and on conversations with the boiler representative (R.F. McDonnald), the existing Cleaver-Brooks Fire-Tube Steam Boiler is not properly trimmed.

The high oxygen content in the flue gasses results in wasteful operation and a low stack temperature. The boiler burner should be retrimmed to about 7% oxygen (rather than the measured 11.65% oxygen) at low fire. Such retrimming will increase the existing stack temperature from 375°F to about 440°F.

The combustion efficiency will be improved from the current 78.0% to about 79.9% which is about a 1.9% improvement. Increasing the steam plant efficiency to 71.4% overall, from an efficiency of about 69.5% assumed after implementation of the energy conservation opportunities involving repairing leaks, reducing steam pressure and installing a properly sized deaerator.

Installation of a stack economizer to recover additional heat to preheat cold makeup water will improve the steam system efficiency an additional 6.7% according to the manufacturer's representative, based on a computer simulation at the low firing rate. The improved steam plant efficiency will, thus be about 78.1% .

Fuel Oil Consumption after leak repairs, new deaerator and steam pressure reduction:	16,723	Million BTU/Year
Revised Annual Fuel Oil Consumption is thus:	15,288	Million BTU/Year
Fuel Oil Savings from Economizer & Oxygen Trim:	**1,435**	**Million BTU/Year**

The circulation pump used for heat recovery will be operated continuously. Based on the manufacturer's system sizing calculations, the flue economizer is sized for a 36 gpm flow rate, with as high as a 4.2 ft head loss. Assuming a 60% efficient circulation pump, about a 1/2 HP motor is required. Electrical requirements are: 8,009 kWH/Year, or 27.3 Million BTU/Year equivalent
This corresponds to 0.91 kW additional electric demand.

Operation and Maintenance

Annual O&M expenses are assumed equal to 1.5% of the construction costs per year for replacing worn components, plus 40 manhours per year for periodic adjustments and calibrations.

Assuming a plumbers rate from Means '94, location adjusted, the annual O&M expenses are estimated at:
$2,501 per year.

CONSTRUCTION COST ESTIMATE

Date Prepared: March-95 | Sheet: 1 of 1

Project: ECIP Facility Energy Improvements | Project No.:

Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada

Basis for Estimate: **Code A (no design competed)**

Engineer-Architect: Keller & Gannon

Drawing No.: Retrofit Flue Economizer & Oxygen Trim Combustion Controls | Estimator: B. I. Horst | Checked By: R. C. Lennig

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Oxygen Trim Combustion Control Retrofit onto Existing Cleaver-Brooks Boiler							
Oxygen Trim Combustion Control Retrofit Package	1	EA	$1,500	$1,500	$15,000	$15,000	$16,500
Flue Economizer Heat Recovery Package							
Thermostack Waste Heat Reclaim Unit, Model TS-130	1	EA	$2,000	$2,000	$9,000	$9,000	$11,000
Oper Unit Package, including Pump, T&P Relief, Valves, Thermostat, etc.	1	EA	$237	$237	$556	$556	$793
Steel Pipe, 1-1/2", Schedule 80 including 10% allowance for fittings	200	LF	$13.26	$2,651	$3.96	$791	$3,442
Fiberglass Insulation, 1-1/2" Wall, 1-1/2" Pipe, All Service Jacket	200	LF	$4.59	$917	$1.64	$327	$1,244
Aluminum Jacket, 0.016"	196	SF	$5.10	$1,001	$0.56	$110	$1,111
Circulating Pump: 1/2 HP	2	EA	$152	$305	$1,181	$2,362	$2,667
Wiring & Conduit	80	LF	$5.16	$412	$1.90	$152	$564
Motor Starter (Mechanical Room)	1	EA	$83	$83	$94	$94	$177
Subtotal				$9,107		$28,392	$37,500
Nevada Sales Tax	3.75%	%		-		$1,065	$1,065
Subtotal							$38,564
Contractor OH & Profit	25.0%	%					$9,641
Subtotal							$48,205
Bond	1.5%	%					$723
Subtotal							$48,929
Estimating Contingency	10.0%	%					$4,893
Total Probable Construction Cost							**$53,821**

Building Envelope & HVAC Controls Retrofits - Detailed Calculations

Building HVAC system energy saving modifications and repairs recommended for implementation include:

- DDC controls retrofits to replace existing pneumatic controls,
- Installation of air curtains to reduce infiltration from open roll-up doors,
- Heat recovery from exhausted conditioned air, and
- Modify ethylene-glycol pump control to cycle on only when heat is needed.

Energy savings are estimated using Carrier Corporation's Hourly Analysis Program (HAP-30), a computerized HVAC energy use simulation program.

Three representative WADF buildings are modeled; results of these simulations are extended to other WADF buildings. Separate simulations are provided for each functional area of the "model" buildings, including:

- Control Rooms / Office Areas (often including toilets and break rooms),
- Work / Processing Areas, e.g., "Towers" in buildings 117-5 and 117-6, and
- Mechanical Rooms

Results of functional area HVAC energy use simulations are extended to "similar" buildings on a floor area basis separately for each functional area. Calculations are shown on Table 3. Energy costs and life cycle cost analysis discount factors used for evaluations are shown on Table 4.

Building Envelope Modifications (Insulation Retrofits)

During field investigations, it was discovered that all non-industrial building areas are already insulated. Insulation includes rigid roof insulation and fiberglass type wall insulation. Industrial type processing areas are not insulated now and should not be insulated on the building interior in the future due to the possibility of contamination by explosive materials. An evaluation of exterior fiberglass batt wall insulation in combination with steel siding for buildings 117-3 and 117-5 yields negative economics, consequently, no additional energy conservation calculations are conducted for insulation retrofits.

DDC Controls Retrofit

All WADF building HVAC systems currently have pneumatic controls. While pneumatic process controls are calibrated periodically, building HVAC system controls, for the most part, are not. This is due to limited maintenance staffing. In addition to uncalibrated controls, several HVAC systems require repairs before they can be operated as designed.

Energy Savings

Energy savings are achievable by installing DDC controls to replace existing pneumatic controls. Some of the features that DDC controls can provide include:

- Heating and cooling supply air temperature reset,
- Proper space temperature control, and
- Night and weekend (scheduled down time) temperature set-back controls.

Energy cost savings are based on energy use simulations, calculations are shown on Table 3. Electric demand savings of about 7.6 kW are realized by disconecting each instrument air compressor.

Operation & Maintenance Cost Savings

Operation and maintenance costs will be reduced with the utilization of DDC control systems. Calibration is required less frequently than with pneumatic controls. Pneumatic controls must be calibrated at least twice annually; DDC controls require calibration no more than once per year. Additional maintenance is required for pneumatic controls because they are typically less reliable at maintaining setpoints than are DDC controls. Assuming an electrician at $41.58 per hour (location adjusted value from Means '94) requires 2 PN, 8 hours per system for calibrating pneumatic controls and an additional 16 MH per year of miscellaneous maintenance work, and only 2 hours per system to calibrate DDC controls once per year:

(2 pneumatic cals. x 2PN x 8 Hours/calibration + 16 Hours) x $41.58/MH =	$1,996	per year O&M Cost
1 DDC calibration/year x 2 Hours/calibration x $41.58/MH =	$83	per year O&M Cost
O&M Cost Savings per Year per HVAC System	**$1,913**	**per year O&M Cost**

DDC Controls Construction Cost and Investment

Construction costs for DDC controls retrofits and HVAC system repairs are provided on the attached construction cost estimates. The levels of investment required are somewhat misleading as the DDC control costs constitute replacement of an existing, nonfunctional, system by upgrading. As such, the cost of replacing existing nonfunctional pneumatic controls and HVAC system repairs are avoided.

Existing pneumatic control system sensors and control components have been contaminated with plant air, compressed air provided from building 117-2. Instrument air compressors in each mechanical room have been cross-connected with plant air systems. While this appears to make sense, the two compressed air systems operate differently. Instrument Air is dry and oil-free, Plant Air is dry, but contains some oil from the compressors located in building 117-2. This oil has contaminated sensitive sensors and other pneumatic control system components, necessitating their replacement.

Pneumatic control systems, according to Means '94, require similar installation costs to DDC control systems. Materials are about 15% less costly. Avoided costs of repairing pneumatic controls are, thus, the same as costs for DDC controls with reduced materials costs. The same "below-the-line" factors are applied.

Recommended economic analysis life times for ECIP type projects categorized as EMCS or HVAC controls is 10 years according to the latest guidance.

Install Air Curtains on Roll-up Doors

Large doors in most of the industrial facilities must stay open during most of the scheduled operating hours to accommodate movement of materials from one building to another. Conditioned air is lost through the open doors.

Plastic strip curtains were installed on several openings some years ago in an attempt to eliminate infiltration from open doors. While strip curtains are often effective in similar warehousing operations, they have proved ineffective at WADF because they have become contaminated (discolored) with explosives and have created a hazard to forklift operators moving munitions. The hazard is two-fold: visibility is limited due to discoloration caused by contact with explosives particulates and sunlight and the heavy strips hit the forklift operators when they execute turns close to the doorways. In at least one case, a load of munitions was spilled

Installation of air curtains will perform the same function as plastic strip curtains without the hazards. A continuous, high velocity stream of air is directed from the top to bottom of door openings via special fans. Th disadvantage is that power is consumed by the fans. Energy savings from reduced losses of conditioned air is balanced against increased fan electrical energy consumption.

Energy savings are determined using the HAP-30 HVAC Energy Use Simulation computer program. Results are provided on Table 3.

Annual operations and maintenance costs are minimal for air curtains. Assume 1/2 hour per year of electrician's time per building to check and/or adjust: 0.5 MH x $41.58/MH = $20.79 /Year

Exhaust Air Heat Recovery

Building exhausts contain conditioned air. Recovery of heat in this exhausted air can be recovered for reuse in conditioning fresh outside air introduced into the buildings.

Several methods are available for recovering thermal energy from air streams. Heat recovery methods include:

- Heat Pipes: Tubular vessels (pipes) containing a refrigerant. One end of the pipe is exposed in an exhaust air stream, the other in a supply air stream. Depending on the tilt of the pipe, refrigerant is evaporated at one side and condensed at the other side, transferring heat via the phase changes. This method is only applicable when the two air streams are in close proximity. This method is not applicable to WADF buildings because of this restriction.
- Thermal Wheels: Metallic surfaces which are exposed to one air stream for a period of time and are then rotated into another air stream, releasing their heat. Thermal wheels must be exposed to both the exhaust and supply air streams, and the air streams must be next to each other. The exhaust air streams in WADF facilities may contain some dust that is explosive (although systems are designed to prevent this from occurring). For this reason - the prevention of contamination of supply air with explosives- thermal wheels have been ruled out as a potential heat recovery method.
- Run-Around Loops: Heat transfer coils are installed at the exhaust and fresh air intakes. Water or a ethylene glycol - water mixture is pumped around the loop, from one coil to another, transferring heat from one air stream to the other. The advantages of this arrangement include non-contamination and the flexibility of serving air streams that may not be located close together. The disadvantage is that the system requires a pump, reducing the amount of energy that may be recovered due to pumping energy requirements.

The third method, run-around loops, is the only heat recovery technology considered that is suitable for application in WADF facilities.

Heat recovery is considered for industrial facilities at WADF, exclusively between work area exhausts and outside air intakes.

Energy savings are determined using the computer HVAC energy use simulation program HAP-30.

Facilities included and the dimensions of their work area exhausts and fresh air intakes are as follows:

Building Number	Exhaust In. x In.	Air Flow CFM	OAS In. x In.	Air Flow CFM	Data Source
117-5	24x48,8EA	1,188 EA	120 x 42	9,500	From As-Built Plans
117-6N	24x48,7EA	1,200 EA	120 x 42	6,300	From As-Built Plans
117-6S	24x48,7EA	1,143 EA	120 x 42	8,000	From As-Built Plans

Facilities which are not included in analyses for exhaust heat recovery and reasons for their exclusions are:

117-1 Exhaust heat recovery not considered; configuration of HVAC system will not easily accommodate required equipment.
117-2 HVAC System is not applicable for heat recovery
117-3 Additional fan energy usage costs exceeds cooling and heating energy cost savings. Process heat recovery for HVAC use is considered separately.
117-6A Building does not have an air handling system
117-7 Exhaust heat recovery not considered; configuration of HVAC system will not easily accommodate required equipment.
117-8 Configuration similar to Bldg 117-3: N/A
117-10 Configuration similar to Bldg 117-3: N/A
117-11 HVAC System is not applicable for heat recovery
117-15 Building has no HVAC system. Process heat recovery is considered separately.

Operation and maintenance for the coils and circulation pumps will require annual cleaning and preventive maintenance. Assume: 16 MH per year x $42.33/MH plumber per system = $677 per year per system

Modify Ethylene-Glycol Circulation Pump Controls

Circulation pumps located in each WADF mechanical room circulate hot ethylene-glycol through steam heat exchangers to heating coils and convectors serving the building HVAC systems. These pumps remain energized throughout the heating season. Heating to the coils is controlled by three-way valves.

Computer simulations of baseline and DDC control retrofit HVAC system energy consumption include consideration of these pumps; no separate calculations are provided.

It should be noted that the original design and installation of pneumatic control systems include pump cycling with heating demand. These controls do not appear to be functioning properly at this time.

Table 3.
Energy Conservation Opportunity Evaluations Based on Computerized HVAC Energy Use Simulations

Building Number	Building Area Description	Building (SF)	Econ Life	Energy Savings: Electric kWH/Year	Energy Savings: Fuel Oil kBTU/Yr	Energy Cost Saved: Electric $/Year	Energy Cost Saved: Fuel Oil $/Year	Energy Cost Saved: Total $/Year	Life Cycle Energy Cost Saved: Electric $LCC	Life Cycle Energy Cost Saved: Fuel Oil $LCC	Life Cycle Energy Cost Saved: Total $LCC	O&M Cost Saved: O&M Saved $/Year	O&M Cost Saved: O&M Saved $LCC	Invest-ment $	SIR	Payback Years
Building HVAC Energy Use Simulation Results																
117-1	DDC Controls	9,181	10	19,374	319,706	$848	$1,959	$2,807	$7,273	$18,848	$26,121	$5,738	$48,945	$105,111	-	-
Totals - Bldg 117-1 DDC Controls Retrofit		9,181	10	19,374	319,706	$848	$1,959	$3,584	$7,273	$18,848	$32,786	$5,738	$48,945	$105,111	1.56	5.98
				7.6	kW Saved	$777	from kW savings		$6,665	from kW savings		Base on 3 HVAC Systems				
117-3	DDC Controls - Control Room	1,711	10	1,789	2,046	$78	$13	$91	$672	$121	$792	$1,913	$16,315	-	-	-
117-3	DDC Controls - Work Areas	9,302	10	1,160	87,705	$51	$537	$588	$435	$5,171	$5,606	$1,913	$16,315	-	-	-
117-3	DDC Controls - Mechanical Room	2,944	10	0	191	$0	$1	$1	$0	$11	$11	$1,913	$16,315	-	-	-
Totals - Bldg 117-3 DDC Controls Retrofit		13,957	10	2,949	89,943	$129	$551	$1,457	$1,107	$5,303	$13,074	$5,738	$48,945	$92,261	1.50	6.23
				7.6	kW Saved	$777	from kW savings		$6,665	from kW savings						
117-5	DDC Controls - Work Room (Tower)	3,679	10	25,141	1,286,064	$1,100	$7,881	$8,981	$9,438	$75,819	$85,257	$1,913	$16,315	-	-	-
117-5	DDC Controls - Mechanical Room & WC's	2,760	10	2,193	390,197	$96	$2,391	$2,487	$823	$23,004	$23,827	$1,913	$16,315	-	-	-
Totals - Bldg 117-5 DDC Controls Retrofit		6,439	10	27,334	1,676,261	$1,196	$10,273	$12,245	$10,261	$98,823	$115,749	$3,825	$32,630	$73,496	2.77	3.40
				7.6	kW Saved	$777	from kW savings		$6,665	from kW savings						
117-5	Air Curtains - Work Room (Tower)	3,679	20	(11,508)	504,317	($503)	$3,091	$2,587	($7,593)	$57,393	$49,800	($21)	($309)	-	-	-
117-5	Air Curtains - Mechanical Room & WC's	2,760	20	0	0	$0	$0	$0	$0	$0	$0	-	-	-	-	-
Totals - Bldg 117-5 Work Room Air Curtain Retrofit		6,439	20	(11,508)	504,317	($503)	$3,091	$2,284	($7,593)	$57,393	$45,227	($21)	($309)	$22,109	2.03	9.77
				(2.97)	kW Saved	($303)	from kW Savings		($4,573)	from kW Savings						
117-5	Exh Ht Recovery - Work Room (Tower)	3,679	20	2,808	783,392	$123	$4,801	$4,924	$1,853	$89,152	$91,005	($677)	($10,078)	-	-	-
117-5	Exh Ht Recovery - Mechanical Room & WC's	2,760	20	(1,045)	727,923	($46)	$4,461	$4,415	($689)	$82,840	$82,151	included	included	-	-	-
Totals - Bldg 117-5 Exhaust Heat Recovery Retrofit		6,439	20	1,763	1,511,315	$77	$9,262	$16,549	$1,164	$171,992	$305,349	($677)	($10,078)	$39,896	7.40	2.51
Similar Buildings (Results of Building 117-3 & 117-5 specific area simulations are extended to similar buildings based on floor square footage)																
117-4AG	DDC Controls - Entire Above Ground Facility	4,810	10	600	45,352	$26	$278	$304	$225	$2,674	$2,899	$1,913	$16,315	-	-	-
117-4UG	DDC Controls - Offices, Toilets & Control Room	1,719	10	1,797	2,056	$79	$13	$91	$675	$121	$796	$1,913	$16,315	-	-	-
117-4UG	DDC Controls - Mechanical Room	2,204	10	0	0	$0	$0	$0	$0	$0	$0	$1,913	$16,315	-	-	-
Totals - Bldg 117-4 DDC Controls Retrofit		8,733	10	2,397	47,408	$105	$291	$1,172	$900	$2,795	$10,359	$5,738	$48,945	$89,030	1.42	6.54
				7.6	kW Saved	$777	from kW savings		$6,665	from kW savings						
117-6	DDC Controls - Office, Lab & Toilets	1,352	10	1,414	1,617	$62	$10	$72	$531	$95	$626	$1,913	$16,315	-	-	-
117-6	DDC Controls - Work Area (Towers)	5,208	10	35,590	1,820,555	$1,557	$11,157	$12,714	$13,361	$107,330	$120,691	$3,825	$32,630	-	-	-
117-6	DDC Controls - Mechanical Rooms	5,220	10	4,147	737,982	$181	$4,523	$4,704	$1,557	$43,507	$45,064	$3,825	$32,630	-	-	-
Totals - Building 117-6 DDC Controls Retrofit		11,780	10	41,151	2,560,153	$1,800	$15,689	$19,043	$15,448	$150,933	$179,710	$9,563	$81,576	$184,094	2.17	4.34
				15.2	kW Saved	$1,554	from kW savings		$13,329	from kW savings						
117-6	Tower Air Curtains - Office, Lab & Toilets	1,352	20	0	0	$0	$0	$0	$0	$0	$0	-	-	-	-	-
117-6	Tower Air Curtains - Work Area (Towers)	5,208	20	(16,290)	713,912	($713)	$4,375	$3,662	($10,748)	$81,245	$70,497	($21)	($309)	-	-	-
117-6	Tower Air Curtains - Mechanical Rooms	5,220	20	0	0	$0	$0	$0	$0	$0	$0	-	-	-	-	-
Totals - Bldg 117-6 Work Room Air Curtain Retrofit		11,780	20	(16,290)	713,912	($713)	$4,375	$3,460	($10,748)	$81,245	$67,449	($21)	($309)	$15,668	4.29	4.56
				(1.98)	kW Saved	($202)	from kW Savings		($3,049)	from kW Savings						
117-6	Exhaust Heat Recovery - Office, Lab & Toilets	1,352	20	0	0	$0	$0	$0	$0	$0	$0	-	-	-	-	-
117-6	Exhaust Heat Recovery - Work Area (Towers)	5,208	20	3,975	1,108,971	$174	$6,796	$6,970	$2,623	$126,204	$128,827	($677)	($10,078)	-	-	-
117-6	Exhaust Heat Recovery - Mechanical Rooms	5,220	20	(1,976)	1,376,724	($86)	$8,437	$8,351	($1,304)	$156,676	$155,372	($677)	($10,078)	-	-	-
Totals - Bldg 117-6 Exhaust Heat Recovery Retrofit		11,780	20	1,999	2,485,695	$87	$15,233	$15,302	$1,319	$282,880	$283,912	($1,355)	($20,156)	$73,565	3.59	5.27
				(0.19)	kW Saved	($19)	from kW savings		($287)	from kW savings						

Table 3.
Energy Conservation Opportunity Evaluations Based on Computerized HVAC Energy Use Simulations

Building Number	Building Area Description	Building (SF)	Econ Life	Energy Savings Electric kWH/Year	Energy Savings Fuel Oil kBTU/Yr	Energy Cost Saved Electric $/Year	Energy Cost Saved Fuel Oil $/Year	Energy Cost Saved Total $/Year	Life Cycle Energy Cost Saved Electric $LCC	Life Cycle Energy Cost Saved Fuel Oil $LCC	Life Cycle Energy Cost Saved Total $LCC	O&M Cost Saved O&M Saved $/Year	O&M Cost Saved O&M Saved $LCC	Invest-ment $	SIR	Payback Years
117-8	DDC Controls - Work Areas	5,350	10	667	50,443	$29	$309	$338	$250	$2,974	$3,224	$1,913	$16,315	-	-	-
117-8	DDC Controls - Office, Control Room & Toilets	1,112	10	1,163	1,330	$51	$8	$59	$436	$78	$515	$1,913	$16,315	-	-	-
117-8	DDC Controls - Mechanical Room	1,672	10	0	109	$0	$1	$1	$0	$6	$6	$1,913	$16,315	-	-	-
Totals - Building 117-8 DDC Controls Retrofit		8,134	10	1,830	51,882	$80	$318	$1,175	$687	$3,059	$10,410	$5,738	$48,945	$96,549	1.37	6.81
				7.6	kW Saved	$777	from kW savings		$6,665	from kW savings						
117-10	DDC Controls - Work Areas	3,339	10	416	31,482	$18	$193	$211	$156	$1,856	$2,012	$1,913	$16,315	-	-	-
117-10	DDC Controls - Office, Control Room & Toilets	1,444	10	1,510	1,727	$66	$11	$77	$567	$102	$669	$1,913	$16,315	-	-	-
117-10	DDC Controls - Mechanical Room	4,193	10	1	272	$0	$2	$2	$0	$16	$16	$1,913	$16,315	-	-	-
117-11	DDC Controls - Entire Building	2,471	10	308	23,298	$13	$143	$156	$116	$1,374	$1,489	$1,913	$16,315	-	-	-
Totals - Buildings 117-10 & 117-11 DDC Controls		8,976	10	1,927	33,481	$84	$205	$1,066	$723	$1,974	$9,362	$5,738	$48,945	$98,744	1.34	6.94
				7.6	kW Saved	$777	from kW savings		$6,665	from kW savings						

Adjustment for Reno vs. Hawthorne, Nevada Energy Use:

Location	Heating DD/Year	Cooling DD/Year
Simulations @ Reno Nevada	6,022	329
Actual Site Hawthorne (WADF)	5,508	487
Adjustment Factors:	0.915	1.480

Energy Costs and Adjustment Factors

Electric Usage Cost & Taxes, **including demand charges:**		
$0.0438 per kWH	8.58 = 10 Yr UPV	15.08 = 20 Yr UPV
Distillate Fuel Oil Cost, including Taxes:		
$6.1283 per Mil BTU's	9.62 = 10 Yr UPV	18.57 = 20 Yr UPV
Non-Energy Cash Flows		
	8.53 = 10 Yr UPV	14.88 = 20 Yr UPV

Table 4.
Energy Costs and Life Cycle Cost Analysis Factors

Electricity Costs

Electric Power Costs (Sierra Pacific Power Corporation Rate E93):

Energy	($/kWH)	$0.0438
Demand	($/kW-Month)	$8.517

No. 2 Fuel Oil (Distillate) Cost

Cost per Gallon:	$0.850	=	$6.128	per Million BTUs

Life Cycle Cost Analysis Discount Factors

NISTIR 85-3273-9 Used for Discount Factors: October 1994, Census Region 4, Industrial

Electricity UPV	10 year =	8.58	15 Year =	12.02	20 Year =	15.08
Distillate Fuels UPV	10 year =	9.62	15 Year =	14.23	20 Year =	18.57
Non-Energy UPV	10 year =	8.53	15 Year =	11.94	20 Year =	14.88

SPW year	1	0.971
	2	0.943
	3	0.915
	4	0.888
	5	0.863
	6	0.837
	7	0.813
	8	0.789
	9	0.766
	10	0.744
	11	0.722
	12	0.701
	13	0.681
	14	0.661
	15	0.642

Development of Electricity Costs for Analyses

Base Prices per Sierra Pacific Power Company Rate Schedule R-1

	Base		Adjustment	Revised Prices
Customer Charge	$1,247	per Month	none	
Demand Charge	$8.74	per kW per Month	($0.2229)	$8.51713
Energy Charge	$0.04484	per kWH	($0.0011)	$0.04375

Adjustments to these prices are made as follows:

Table 4.
Energy Costs and Life Cycle Cost Analysis Factors

Fuel Adjustment

Month	Fuel Adjustment projected for 1995 ($ per kWH)
January	0.00220
February	(0.00121)
March	(0.00118)
April	0.00022
May	0.00031
June	(0.00050)
July	(0.00027)
August	0.00217
September	(0.00140)
October	0.00033
November	(0.00018)
December	0.00019
Average	**0.00006**

Power Factor Adjustment

Power factor adjustment is applied to both the energy and demand charges:

0.15% cost adjustment per % above or below power factor of 80%.
Hawthorne has capacitor banks to correct the power factor. The power factor is maintained at about 97%, continuously. Thus, the price reduction is:

(97% - 80%) x 0.15% = 2.550% reduction in demand and usage charges.

Table 5.
DDC Controls Retrofit Input-Output Summary

BUILDING DDC CONTROLS RETROFIT	HARDWARE REQUIREMENTS																																				
	OUTPUT FROM DDC CONTROLS									INPUT TO DDC CONTROLS																		ALARMS									
	DIGITAL						ANALOG			DIGITAL								ANALOG										DIGITAL			ANALOG						
BUILDING NUMBER & POINT DESCRIPTION	CONTROL RELAY	SOLENOID	OFF / AUTO	P/E RELAY	SELECTOR RELAY		CONTROL PT. ADJUSTMENT			HIGH / LOW	PULSE	DIFFERENTIAL PRESS SW	PRESSURE SWITCH	AUXILLARY CONTACT	FLOW SWITCH	GENERAL ALARM		SPACE TEMPERATURE	SUPPLY AIR TEMPERATURE	RETURN AIR TEMPERATUR	PRESSURE, PSIA, PSIG	POSITION SENSOR	STEAM PRESSURE	FLOW	GLYCOL TEMPERATURE	OUTSIDE AIR TEMPERATUR	FLUID TEMPERATURE		CONTACT CLOSURE			HIGH LIMIT	LOW LIMIT	RUN TIME				
Building 117-1 Services & Supply																																					
117-1 AHU - 6 ZONES	3			13										2	1			6	7	1	1	12				1					1	2					
117-1 ELECTRIC COIL	1													1				1	2												1						
UNIT HEATERS	2													2				1																			
GLYCOL HE STEAM CNTRL				2										2								2			2	1											
GLYCOL CIRC PUMPS	2													2				2						2													
STEAM PRV STATIONS				2										2								2	4														
GLYCOL MAKE-UP PUMP												1		1										1								1					
STM COND RCVR - PUMPS																								1			1				1						
Subtotal Building 117-1	8	0	0	17	0	0	0	0	0	0	0	1	0	12	1	0	0	10	9	1	1	16	4	4	2	2	0	1	0	0	0	3	3	0	0	0	0
Building 117-3 Decontamination of Small Parts																																					
CONTROL RM AC UNIT	2		1	4										2	1			1	1	1	1	4				1					1	2					
WORK ROOM AC UNIT	1			2										1	1			1	1		1	2				1					1	2					
MECH RM HV UNIT				1														1	1		1	1				1					1	1					
CONVECTOR CONTROL	1													1				1																			
UNIT HEATERS	2													2				1																			
GLYCOL HE STEAM CNTRL				2										2								2			2	1											
GLYCOL CIRC PUMPS	2													2				2						2													
STEAM PRV STATIONS				2										2								2	4														
GLYCOL MAKE-UP PUMP												1		1										1								1					
STM COND RCVR - PUMPS																								1			1				1						
Subtotal Building 117-3	8	0	1	11	0	0	0	0	0	0	0	1	0	13	2	0	0	7	3	1	3	11	4	4	2	4	0	1	0	0	0	4	6	0	0	0	0

Table 5.
DDC Controls Retrofit Input-Output Summary

BUILDING DDC CONTROLS RETROFIT	HARDWARE REQUIREMENTS																																				
	OUTPUT FROM DDC CONTROLS									INPUT TO DDC CONTROLS																				ALARMS								
	DIGITAL						ANALOG			DIGITAL								ANALOG												DIGITAL			ANALOG					
BUILDING NUMBER & POINT DESCRIPTION	CONTROL RELAY	SOLENOID	OFF / AUTO	P/E RELAY	SELECTOR RELAY		CONTROL PT. ADJUSTMENT			HIGH / LOW	PULSE	DIFFERENTIAL PRESS SW	PRESSURE SWITCH	AUXILLARY CONTACT	FLOW SWITCH	GENERAL ALARM		SPACE TEMPERATURE	SUPPLY AIR TEMPERATURE	RETURN AIR TEMPERATUR	PRESSURE, PSIA, PSIG	POSITION SENSOR	STEAM PRESSURE	FLOW	GLYCOL TEMPERATURE	OUTSIDE AIR TEMPERATUR	FLUID TEMPERATURE		CONTACT CLOSURE			HIGH LIMIT	LOW LIMIT	RUN TIME			
Building 117-4 Bulk Explosives Disposal																																					
CONTROL RM AC UNIT	2		1	4										2	1			1	1	1	1	4				1						1	2				
WORK ROOM AC UNIT	1			2	1									1	1			1	1		1	2				1						1	2				
MECH RM HV UNIT				1														1	1		1	1				1						1	1				
CONVECTOR CONTROL	1													1				1																			
GLYCOL HE STEAM CNTRL				2										2								2			2	1											
GLYCOL CIRC PUMPS	2													2				2						2													
STEAM PRV STATIONS				2										2								2	4														
GLYCOL MAKE-UP PUMP												1		1										1									1				
STM COND RCVR - PUMPS																								1			1					1				
Subtotal Building 117-4	6	0	1	11	1	0	0	0	0	0	0	1	0	11	2	0	0	6	3	1	3	11	4	4	2	4	0	1	0	0	0	4	6	0	0	0	0
Building 117-5 Refining Building																																					
WORK ROOM AC UNIT	1			2										1	1			1	1		1	2				1						1	2				
MECH RM HV UNIT				1														1	1		1	1				1						1	1				
CONVECTOR CONTROL	1													1				1																			
HEATING COIL CNTRL	1													1				1																			
UNIT HEATERS	2													2				1																			
GLYCOL HE STEAM CNTRL				2										2								2			2	1											
GLYCOL CIRC PUMPS	2													2				2						2													
STEAM PRV STATIONS				2										2								2	4														
GLYCOL MAKE-UP PUMP												1		1										1									1				
STM COND RCVR - PUMPS																								1			1					1				
Subtotal Building 117-5	7	0	0	7	0	0	0	0	0	0	0	1	0	12	1	0	0	7	2	0	2	7	4	4	2	3	0	1	0	0	0	3	4	0	0	0	0

Table 5.
DDC Controls Retrofit Input-Output Summary

BUILDING DDC CONTROLS RETROFIT	HARDWARE REQUIREMENTS																																					
	OUTPUT FROM DDC CONTROLS									INPUT TO DDC CONTROLS																				ALARMS									
	DIGITAL						ANALOG			DIGITAL								ANALOG												DIGITAL			ANALOG						
BUILDING NUMBER & POINT DESCRIPTION	CONTROL RELAY	SOLENOID	OFF / AUTO	P/E RELAY	SELECTOR RELAY		CONTROL PT. ADJUSTMENT			HIGH / LOW	PULSE	DIFFERENTIAL PRESS SW	PRESSURE SWITCH	AUXILLARY CONTACT	FLOW SWITCH	GENERAL ALARM		SPACE TEMPERATURE	SUPPLY AIR TEMPERATURE	RETURN AIR TEMPERATUR	PRESSURE, PSIA, PSIG	POSITION SENSOR	STEAM PRESSURE	FLOW	GLYCOL TEMPERATURE	OUTSIDE AIR TEMPERATUR	FLUID TEMPERATURE		CONTACT CLOSURE			HIGH LIMIT	LOW LIMIT	RUN TIME				
Building 117-6 Steamout Building																																						
N. LAB & WC AC UNIT	2		1	4										2	1			1	1	1	1	4				1						1	2					
N. WORK TOWER AC UNIT	1			2										1	1			1	1		1	2				1						1	2					
N. MECH RM HV UNIT				1														1	1		1	1				1						1	1					
N. CONVECTOR CNTRL	1													1				1																				
N. MECH RM UNIT HTR	1													1				1																				
S. CNTRL RM AC UNIT	2		1	4										2	1			1	1	1	1	4				1						1	2					
S. WORK TOWER AC UNIT	1			2										1	1			1	1		1	2				1						1	2					
S. MECH RM HV UNIT				1														1	1		1	1				1						1	1					
S. CONVECTOR CNTRL	1													1				1																				
S. CONVECTOR CNTRL	1													1				1																				
S. MECH RM UNIT HTR	1													1				1																				
GLYCOL HE STEAM CNTRL				4										4								4			4	2												
GLYCOL CIRC PUMPS	4													4				4						4														
STEAM PRV STATIONS				4										4								4	8														
GLYCOL MAKE-UP PUMP												2		2										2									2					
STM COND RCVR - PUMPS																								2			2					2					
Subtotal Building 117-6	15	0	2	22	0	0	0	0	0	0	0	2	0	25	4	0	0	15	6	2	6	22	8	8	4	8	0	2	0	0	0	8	12	0	0	0	0

Table 5.
DDC Controls Retrofit Input-Output Summary

BUILDING DDC CONTROLS RETROFIT	HARDWARE REQUIREMENTS																																							
	OUTPUT FROM DDC CONTROLS									INPUT TO DDC CONTROLS																					ALARMS										
	DIGITAL					ANALOG				DIGITAL								ANALOG												DIGITAL			ANALOG								
BUILDING NUMBER & POINT DESCRIPTION	CONTROL RELAY	SOLENOID	OFF / AUTO	P/E RELAY	SELECTOR RELAY		CONTROL PT. ADJUSTMENT			HIGH / LOW	PULSE	DIFFERENTIAL PRESS SW	PRESSURE SWITCH	AUXILLARY CONTACT	FLOW SWITCH	GENERAL ALARM			SPACE TEMPERATURE	SUPPLY AIR TEMPERATURE	RETURN AIR TEMPERATUR	PRESSURE, PSIA, PSIG	POSITION SENSOR	STEAM PRESSURE	FLOW	GLYCOL TEMPERATURE	OUTSIDE AIR TEMPERATUR	FLUID TEMPERATURE			CONTACT CLOSURE			HIGH LIMIT	LOW LIMIT	RUN TIME					
Building 117-8 Mechanical Removal Building																																								
CONTROL RM AC UNIT	2		1	4										2	1				1	1	1	1	4				1						1	2						
WORK ROOM AC UNIT	1			2										1	1				1	1		1	2				1						1	2						
MECH RM HV UNIT				1															1	1		1	1				1						1	1						
CONVECTOR CONTROL	1													1					1																						
HEATING COIL CNTRL	1													1					1																						
UNIT HEATERS	2													2					1																						
DOOR HEATERS	1													1					1																						
GLYCOL HE STEAM CNTRL				2										2									2			2	1														
GLYCOL CIRC PUMPS	2													2					2						2																
STEAM PRV STATIONS				2										2									2	4																	
GLYCOL MAKE-UP PUMP												1		1											1									1								
STM COND RCVR - PUMPS																									1			1						1							
Subtotal Building 117-8	10	0	1	11	0	0	0	0	0	0	0	1	0	15	2	0	0	9	3	1	3	11	4	4	2	4	0	1	0	0	0	4	6	0	0	0	0			

Table 5.
DDC Controls Retrofit Input-Output Summary

BUILDING DDC CONTROLS RETROFIT	HARDWARE REQUIREMENTS																																							
	OUTPUT FROM DDC CONTROLS									INPUT TO DDC CONTROLS																				ALARMS										
	DIGITAL						ANALOG			DIGITAL								ANALOG												DIGITAL			ANALOG							
BUILDING NUMBER & POINT DESCRIPTION	CONTROL RELAY	SOLENOID	OFF / AUTO	P/E RELAY	SELECTOR RELAY		CONTROL PT. ADJUSTMENT			HIGH / LOW	PULSE	DIFFERENTIAL PRESS SW	PRESSURE SWITCH	AUXILLARY CONTACT	FLOW SWITCH	GENERAL ALARM		SPACE TEMPERATURE	SUPPLY AIR TEMPERATURE	RETURN AIR TEMPERATURE	PRESSURE, PSIA, PSIG	POSITION SENSOR	STEAM PRESSURE	FLOW	GLYCOL TEMPERATURE	OUTSIDE AIR TEMPERATUR	FLUID TEMPERATURE		CONTACT CLOSURE			HIGH LIMIT	LOW LIMIT	RUN TIME					
Buildings 117-10 & 117-11 Preparation Building and Accumulator Building																																							
CONTROL RM AC UNIT	2		1	4										2	1			1	1	1	1	4				1						1	2					
WORK ROOM AC UNIT	1			2										1	1			1	1		1	2				1						1	2					
MECH RM HV UNIT				1														1	1		1	1				1						1	1					
CONVECTOR CONTROL	1													1				1																				
HEATING COIL CNTRL	1													1				1																				
UNIT HEATERS	2													2				1																				
DOOR HEATERS	2													2				2																				
GLYCOL HE STEAM CNTRL				2										2								2			2	1												
GLYCOL CIRC PUMPS	2													2				2						2														
STEAM PRV STATIONS				2										2								2	4															
GLYCOL MAKE-UP PUMP												1		1										1									1					
STM COND RCVR - PUMPS																								1			1					1					
Subtotal Bldgs 117-10&11	11	0	1	11	0	0	0	0	0	0	0	1	0	16	2	0	0	10	3	1	3	11	4	4	2	4	0	1	0	0	0	4	6	0	0	0	0
TOTAL DDC CONTROLS	65	0	6	90	1	0	0	0	0	0	0	8	0	##	14	0	0	64	29	7	21	89	32	32	16	29	0	8	0	0	0	30	43	0	0	0	0

CONSTRUCTION COST ESTIMATE

Date Prepared: March-95 | Sheet: 1 of 7

Project: ECIP Facility Energy Improvements | Project No.: | Basis for Estimate: Code A (no design competed)

Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada

Engineer-Architect: Keller & Gannon

Drawing No.: HVAC - DDC Controls Retrofit | Estimator: B. I. Horst | Checked By: R. C. Lennig

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Building 117-1 Services & Support Building - HVAC System Repairs							
Damper Actuators - Pneumatic	9	EA	$50	$450	$62	$558	$1,008
Repair all HVAC System Dampers	9	EA	$144	$1,296	$132	$1,189	$2,485
Duct Repairs and Duct Cleaning	1	Job	$1,000	$1,000	$250	$250	$1,250
Balance Air Distribution System	1	Job	Included		$954	$954	$954
Subtotal Bldg 117-1 HVAC Repair				**$2,746**		**$2,951**	**$5,697**
Building 117-1 Services & Support Building - DDC Controls Retrofit							
Control Relay	8	EA	$50	$400	$300	$2,400	$2,800
P/E Relay	17	EA	$55	$943	$130	$2,210	$3,153
Differential Pressure Switch	1	EA	$50	$50	$730	$730	$780
Auxilliary Contact	12	EA	$50	$600	$350	$4,200	$4,550
Flow Switch	1	EA	$50	$50	$470	$470	$940
Space Temperature (Thermostat)	10	EA	$83	$832	$527	$5,268	$6,100
Supply Air Temperature	9	EA	$67	$599	$273	$2,461	$3,060
Return Air Temperature	1	EA	$67	$67	$273	$273	$340
Pressure Sensor	1	EA	$83	$83	$485	$485	$568
Position Sensor	16	EA	$67	$1,064	$300	$4,800	$5,864
Steam Pressure	4	EA	$67	$268	$873	$3,492	$3,760
Flow	4	EA	$83	$333	$2,117	$8,467	$8,800
Glycol Temperature	2	EA	$67	$133	$533	$1,067	$1,200
Outside Air Temperature	2	EA	$67	$133	$273	$547	$680
High Limit	3	EA	$50	$150	$270	$810	$960
Low Limit	3	EA	$50	$150	$270	$810	$960
DDC Control Unit - 32 Point	3	EA	$750	$2,250	$4,250	$12,750	$15,000
Subtotal Bldg 117-1 DDC Cntrls	94	Sensors/Cntrls		**$8,104**		**$51,242**	**$59,516**
Building 117-1 HVAC Repairs & DDC Controls				**$10,850**		**$54,193**	**$65,213**
Nevada Sales Tax	3.75%	%		-		$2,032	$2,032
Subtotal							$67,245
Contractor OH & Profit	25.0%	%					$16,811
Subtotal							$84,057
Bond	1.5%	%					$1,261
Subtotal							$85,318
Estimating Contingency	10.0%	%					$8,532
Total Probable Construction Cost: DDC Controls & HVAC Repairs							**$93,849**

Avoided Cost of Repairs & Replacements	**$10,850**	**$46,507**	**$82,483**

CONSTRUCTION COST ESTIMATE					Date Prepared March-95		Sheet 2 of 7
Project ECIP Facility Energy Improvements				Project No.	Basis for Estimate		
Location Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada					Code A (no design competed)		
Engineer-Architect Keller & Gannon							
Drawing No. HVAC - DDC Controls Retrofit		Estimator B. I. Horst			Checked By R. C. Lennig		
Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Building 117-3 Decontamination of Small Items Building - HVAC Repairs							
Repair all HVAC System Dampers	4	EA	$144	$576	$132	$528	$1,104
Duct Repairs and Duct Cleaning	1	Job	$1,000	$1,000	$250	$250	$1,250
Balance Air Distribution System	1	Job	Included		$954	$954	$954
Subtotal Bldg 117-3 HVAC Repair				**$1,576**		**$1,732**	**$3,308**
Building 117-3 Decontamination of Small Items Building - DDC Controls Retrofit							
Control Relay	8	EA	$50	$400	$300	$2,400	$2,800
On/Off Relay	1	EA	$50	$50	$500	$500	$550
P/E Relay	11	EA	$55	$610	$130	$1,430	$2,040
Differential Pressure Switch	1	EA	$50	$50	$730	$730	$780
Auxilliary Contact	13	EA	$50	$650	$350	$4,550	$5,200
Flow Switch	2	EA	$50	$100	$470	$940	$1,040
Space Temperature (Thermostat)	7	EA	$83	$582	$527	$3,688	$4,270
Supply Air Temperature	3	EA	$67	$200	$273	$820	$1,020
Return Air Temperature	1	EA	$67	$67	$273	$273	$340
Pressure Sensor	3	EA	$83	$249	$485	$1,455	$1,704
Position Sensor	11	EA	$67	$732	$300	$3,300	$4,032
Steam Pressure	4	EA	$67	$268	$873	$3,492	$3,760
Flow	4	EA	$83	$333	$2,117	$8,467	$8,800
Glycol Temperature	2	EA	$67	$133	$533	$1,067	$1,200
Outside Air Temperature	4	EA	$67	$266	$273	$1,094	$1,360
High Limit	4	EA	$50	$200	$270	$1,080	$1,280
Low Limit	6	EA	$50	$300	$270	$1,621	$1,921
DDC Control Unit - 32 Point	3	EA	$750	$2,250	$4,250	$12,750	$15,000
Subtotal Bldg 117-3 DDC Cntrls	85	Sensors/Cntrls		**$7,439**		**$49,658**	**$57,097**
Building 117-3 HVAC Repairs & DDC Controls				**$9,015**		**$51,391**	**$60,406**
Nevada Sales Tax	3.75%	%		-		$1,927	$1,927
Subtotal							$59,025
Contractor OH & Profit	25.0%	%					$14,756
Subtotal							$73,781
Bond	1.5%	%					$1,107
Subtotal							$74,887
Estimating Contingency	10.0%	%					$7,489
Total Probable Construction Cost							**$82,376**

Avoided Cost of Repairs & Replacements	**$9,015**		**$43,942**	**$76,208**

CONSTRUCTION COST ESTIMATE	Date Prepared March-95	Sheet 3 of 7
Project: ECIP Facility Energy Improvements	Project No.	Basis for Estimate
Location: Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada		Code A (no design competed)
Engineer-Architect: Keller & Gannon		
Drawing No.: HVAC - DDC Controls Retrofit	Estimator: B. I. Horst	Checked By: R. C. Lennig

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Building 117-4 Bulk Explosives Disposal Building - DDC Control Retrofit							
Control Relay	6	EA	$50	$300	$300	$1,800	$2,100
On/Off Relay	1	EA	$50	$50	$500	$500	$550
P/E Relay	11	EA	$55	$610	$130	$1,430	$2,040
Selector Relay	1	EA	$111	$111	$64	$64	$174
Differential Pressure Switch	1	EA	$50	$50	$730	$730	$780
Auxilliary Contact	11	EA	$50	$550	$350	$3,850	$4,400
Flow Switch	2	EA	$50	$100	$470	$940	$1,040
Space Temperature (Thermostat)	6	EA	$83	$499	$527	$3,161	$3,660
Supply Air Temperature	3	EA	$67	$200	$273	$820	$1,020
Return Air Temperature	1	EA	$67	$67	$273	$273	$340
Pressure Sensor	3	EA	$83	$249	$485	$1,455	$1,704
Position Sensor	11	EA	$67	$732	$300	$3,300	$4,032
Steam Pressure	4	EA	$67	$268	$873	$3,492	$3,760
Flow	4	EA	$83	$333	$2,117	$8,467	$8,800
Glycol Temperature	2	EA	$67	$133	$533	$1,067	$1,200
Outside Air Temperature	4	EA	$67	$266	$273	$1,094	$1,360
High Limit	4	EA	$50	$200	$270	$1,080	$1,280
Low Limit	6	EA	$50	$300	$270	$1,621	$1,921
DDC Control Unit - 32 Point	3	EA	$750	$2,250	$4,250	$12,750	$15,000
Subtotal Building 117-4	81	Sensors/Cntrls		**$7,267**		**$47,895**	**$55,162**
Nevada Sales Tax	3.75%	%		-		$1,796	$1,796
Subtotal							$56,958
Contractor OH & Profit	25.0%	%					$14,239
Subtotal							$71,197
Bond	1.5%	%					$1,068
Subtotal							$72,265
Estimating Contingency	10.0%	%					$7,226
Total Probable Construction Cost							**$79,491**

Avoided Cost of Pneumatic Controls Repair	**$7,267**	**$40,711**	**$66,958**

CONSTRUCTION COST ESTIMATE					Date Prepared March-95		Sheet 4 of 7
Project ECIP Facility Energy Improvements				Project No.	Basis for Estimate		
Location Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada					Code A (no design competed)		
Engineer-Architect Keller & Gannon							
Drawing No. HVAC - DDC Controls Retrofit			Estimator B. I. Horst		Checked By R. C. Lennig		
Line Item	Quantity		Labor		Material		Total
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Cost
Building 117-5 Refining Building - DDC Controls Retrofit							
Control Relay	7	EA	$50	$350	$300	$2,100	$2,450
P/E Relay	7	EA	$55	$388	$130	$910	$1,298
Differential Pressure Switch	1	EA	$50	$50	$730	$730	$780
Auxilliary Contact	12	EA	$50	$600	$350	$4,200	$4,800
Flow Switch	1	EA	$50	$50	$470	$470	$520
Space Temperature (Thermostat)	7	EA	$83	$582	$527	$3,688	$4,270
Supply Air Temperature	2	EA	$67	$133	$273	$547	$680
Pressure Sensor	2	EA	$83	$166	$485	$970	$1,136
Position Sensor	7	EA	$67	$466	$300	$2,100	$2,566
Steam Pressure	4	EA	$67	$268	$873	$3,492	$3,760
Flow	4	EA	$83	$333	$2,117	$8,467	$8,800
Glycol Temperature	2	EA	$67	$133	$533	$1,067	$1,200
Outside Air Temperature	3	EA	$67	$200	$273	$820	$1,020
High Limit	3	EA	$50	$150	$270	$810	$960
Low Limit	4	EA	$50	$200	$270	$1,080	$1,280
DDC Control Unit - 32 Point	2	EA	$750	$1,500	$4,250	$8,500	$10,000
Subtotal Building 117-5	66	Sensors/Cntrls		**$5,569**		**$39,952**	**$45,521**
Nevada Sales Tax	3.75%	%		-		$1,498	$1,498
Subtotal							$47,019
Contractor OH & Profit	25.0%	%					$11,755
Subtotal							$58,774
Bond	1.5%	%					$882
Subtotal							$59,656
Estimating Contingency	10.0%	%					$5,966
Total Probable Construction Cost							**$65,621**

Avoided Cost of Pneumatic Controls Repair	**$5,569**	**$33,960**	**$55,166**

CONSTRUCTION COST ESTIMATE

Date Prepared: March-95 | Sheet: 5 of 7

Project: ECIP Facility Energy Improvements | Project No.:

Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada

Basis for Estimate: Code A (no design competed)

Engineer-Architect: Keller & Gannon

Drawing No.: HVAC - DDC Controls Retrofit | Estimator: B. I. Horst | Checked By: R. C. Lennig

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Building 117-6 Steamout Building - DDC Controls Retrofit							
Control Relay	15	EA	$50	$750	$300	$4,500	$5,250
On/Off Relay	2	EA	$50	$100	$500	$1,000	$1,100
P/E Relay	22	EA	$55	$1,220	$130	$2,860	$4,080
Differential Pressure Switch	2	EA	$50	$100	$730	$1,460	$1,560
Auxilliary Contact	25	EA	$50	$1,250	$350	$8,750	$10,000
Flow Switch	4	EA	$50	$200	$470	$1,880	$2,080
Space Temperature (Thermostat)	15	EA	$83	$1,247	$527	$7,903	$9,150
Supply Air Temperature	6	EA	$67	$399	$273	$1,641	$2,040
Return Air Temperature	2	EA	$67	$133	$273	$547	$680
Pressure Sensor	6	EA	$83	$499	$485	$2,910	$3,409
Position Sensor	22	EA	$67	$1,464	$300	$6,600	$8,064
Steam Pressure	8	EA	$67	$536	$873	$6,984	$7,520
Flow	8	EA	$83	$665	$2,117	$16,935	$17,600
Glycol Temperature	4	EA	$67	$266	$533	$2,134	$2,400
Outside Air Temperature	8	EA	$67	$532	$273	$2,188	$2,720
High Limit	8	EA	$50	$400	$270	$2,161	$2,561
Low Limit	12	EA	$50	$600	$270	$3,241	$3,841
DDC Control Unit - 32 Point	6	EA	$750	$4,500	$4,250	$25,500	$30,000
Subtotal Building 117-6	169	Sensors/Cntrls		**$14,862**		**$99,193**	**$114,055**
Nevada Sales Tax	3.75%	%		-		$3,720	$3,720
Subtotal							$117,775
Contractor OH & Profit	25.0%	%					$29,444
Subtotal							$147,218
Bond	1.5%	%					$2,208
Subtotal							$149,427
Estimating Contingency	10.0%	%					$14,943
Total Probable Construction Cost							**$164,369**

Avoided Cost of Pneumatic Controls Repair	**$14,862**	**$84,314**	**$138,412**

CONSTRUCTION COST ESTIMATE

Date Prepared: March-95 | Sheet: 6 of 7

Project: ECIP Facility Energy Improvements | Project No.:

Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada

Basis for Estimate: Code A (no design competed)

Engineer-Architect: Keller & Gannon

Drawing No.: HVAC - DDC Controls Retrofit | Estimator: B. I. Horst | Checked By: R. C. Lennig

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Building 117-8 Mechanical Removal Building							
Control Relay	10	EA	$50	$500	$300	$3,000	$3,500
On/Off Relay	1	EA	$50	$50	$500	$500	$550
P/E Relay	11	EA	$55	$610	$130	$1,430	$2,040
Differential Pressure Switch	1	EA	$50	$50	$730	$730	$780
Auxilliary Contact	15	EA	$50	$750	$350	$5,250	$6,000
Flow Switch	2	EA	$50	$100	$470	$940	$1,040
Space Temperature (Thermostat)	9	EA	$83	$748	$527	$4,742	$5,490
Supply Air Temperature	3	EA	$67	$200	$273	$820	$1,020
Return Air Temperature	1	EA	$67	$67	$273	$273	$340
Pressure Sensor	3	EA	$83	$249	$485	$1,455	$1,704
Position Sensor	11	EA	$67	$732	$300	$3,300	$4,032
Steam Pressure	4	EA	$67	$268	$873	$3,492	$3,760
Flow	4	EA	$83	$333	$2,117	$8,467	$8,800
Glycol Temperature	2	EA	$67	$133	$533	$1,067	$1,200
Outside Air Temperature	4	EA	$67	$266	$273	$1,094	$1,360
High Limit	4	EA	$50	$200	$270	$1,080	$1,280
Low Limit	6	EA	$50	$300	$270	$1,621	$1,921
DDC Control Unit - 32 Point	3	EA	$750	$2,250	$4,250	$12,750	$15,000
Subtotal Building 117-8	91	Sensors/Cntrls		**$7,806**		**$52,012**	**$59,817**
Nevada Sales Tax	3.75%	%		-		$1,950	$1,950
Subtotal							$61,768
Contractor OH & Profit	25.0%	%					$15,442
Subtotal							$77,210
Bond	1.5%	%					$1,158
Subtotal							$78,368
Estimating Contingency	10.0%	%					$7,837
Total Probable Construction Cost							**$86,205**

Avoided Cost of Pneumatic Controls Repair	**$7,806**	**$44,210**	**$72,594**

CONSTRUCTION COST ESTIMATE					Date Prepared March-95		Sheet 7 of 7
Project ECIP Facility Energy Improvements				Project No.	Basis for Estimate		
Location Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada					Code A (no design competed)		
Engineer-Architect Keller & Gannon							
Drawing No. HVAC - DDC Controls Retrofit			Estimator B. I. Horst		Checked By R. C. Lennig		
Line Item	Quantity		Labor		Material		Total
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Cost
Building 117-10 Preparation Building & Building 117-11 Accumulator Building							
Control Relay	11	EA	$50	$550	$300	$3,300	$3,850
On/Off Relay	1	EA	$50	$50	$500	$500	$550
P/E Relay	11	EA	$55	$610	$130	$1,430	$2,040
Differential Pressure Switch	1	EA	$50	$50	$730	$730	$780
Auxilliary Contact	16	EA	$50	$800	$350	$5,600	$6,400
Flow Switch	2	EA	$50	$100	$470	$940	$1,040
Space Temperature (Thermostat)	10	EA	$83	$832	$527	$5,268	$6,100
Supply Air Temperature	3	EA	$67	$200	$273	$820	$1,020
Return Air Temperature	1	EA	$67	$67	$273	$273	$340
Pressure Sensor	3	EA	$83	$249	$485	$1,455	$1,704
Position Sensor	11	EA	$67	$732	$300	$3,300	$4,032
Steam Pressure	4	EA	$67	$268	$873	$3,492	$3,760
Flow	4	EA	$83	$333	$2,117	$8,467	$8,800
Glycol Temperature	2	EA	$67	$133	$533	$1,067	$1,200
Outside Air Temperature	4	EA	$67	$266	$273	$1,094	$1,360
High Limit	4	EA	$50	$200	$270	$1,080	$1,280
Low Limit	6	EA	$50	$300	$270	$1,621	$1,921
DDC Control Unit - 32 Point	3	EA	$750	$2,250	$4,250	$12,750	$15,000
Subtotal Buildings 117-10 & 11	94	Sensors/Cntrls		**$7,989**		**$53,189**	**$61,177**
Nevada Sales Tax	3.75%	%		-		$1,995	$1,995
Subtotal							$63,172
Contractor OH & Profit	25.0%	%					$15,793
Subtotal							$78,965
Bond	1.5%	%					$1,184
Subtotal							$80,150
Estimating Contingency	10.0%	%					$8,015
Total Probable Construction Cost							**$88,164**

Avoided Cost of Pneumatic Controls Repair	**$7,989**	**$45,210**	**$74,246**

CONSTRUCTION COST ESTIMATE

Date Prepared: March-95 | Sheet: 1 of 1

Project: ECIP Facility Energy Improvements | Project No.:

Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada

Basis for Estimate: **Code A (no design competed)**

Engineer-Architect: Keller & Gannon

Drawing No.: Install Air Curtains at Roll-up Doors | Estimator: B. I. Horst | Checked By: R. C. Lennig

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Building 117-5 Refining Building - Air Curtains							
Mars (or equal) Model No. C-60C Air Curtain (2 Each per Roll-up Door)	3	Doors	$1,727	$5,182	$2,391	$7,173	$12,356
Door Switch, Explosion Proof	3	EA	$42	$125	$45	$135	$260
Wiring & Conduit, Explosion Proof	100	LF	$5.16	$516	$1.90	$190	$706
Motor Started (Mechanical Room)	3	EA	$83	$249	$94	$282	$531
Subtotal Bldg 117-5 Air Curtains				$6,072		$7,780	$13,853
Nevada Sales Tax	3.75%	%		-		$292	$292
Subtotal							$14,144
Contractor OH & Profit	25.0%	%					$3,536
Subtotal							$17,680
Bond	1.5%	%					$265
Subtotal							$17,946
Estimating Contingency	10.0%	%					$1,795
Total Probable Construction Cost - Building 117-5 Air Curtains							**$19,740**
Building 117-6 Steamout Building - Air Curtains							
Mars (or equal) Model No. C-60C Air Curtain (2 Each per Roll-up Door)	2	Doors	$1,727	$3,455	$2,391	$4,782	$8,237
Door Switch, Explosion Proof	2	EA	$42	$83	$45	$90	$173
Wiring & Conduit, Explosion Proof	150	LF	$5.16	$773	$1.90	$285	$1,058
Motor Started (Mechanical Room)	2	EA	$83	$166	$94	$188	$354
Subtotal Bldg 117-6 Air Curtains				$4,478		$5,345	$9,823
Nevada Sales Tax	3.75%	%		-		$200	$200
Subtotal							$10,024
Contractor OH & Profit	25.0%	%					$2,506
Subtotal							$12,529
Bond	1.5%	%					$188
Subtotal							$12,717
Estimating Contingency	10.0%	%					$1,272
Total Probable Construction Cost - Building 117-6 Air Curtains							**$13,989**

CONSTRUCTION COST ESTIMATE

Date Prepared: March-95 | Sheet: 1 of 2

Project: ECIP Facility Energy Improvements | Project No.:

Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada

Basis for Estimate: Code A (no design competed)

Engineer-Architect: Keller & Gannon

Drawing No.: Exhaust Air Heat Recovery Retrofit | Estimator: B. I. Horst | Checked By: R. C. Lennig

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
Building 117-5 Refining Building - Exhaust Air Heat Recovery - Run-Around Loop							
Exhst Coil: 24" x 48", 3/8" x 0.016" Tube, 0.0065 Al, 2 Row, 8 Fin/Inch	8	EA	$311	$2,485	$649	$5,195	$7,680
Exhst Coil: 16" x 48", 3/8" x 0.016" Tube, 0.0065 Al, 2 Row, 8 Fin/Inch	2	EA	$207	$414	$533	$1,066	$1,480
SA Coil: 42.5" x 105", 1/2" x 0.017" Tube, 0.0065 Al, 2 Row, 8 Fin/Inch	1	EA	$1,196	$1,196	$1,279	$1,279	$2,475
Copper Pipe, 3/4", Type K, including 10% allowance for fittings	722	LF	$4.36	$3,146	$2.72	$1,960	$5,106
Fiberglass Insulation, 1-1/2" Wall, 3/4" Pipe, All Service Jacket	722	LF	$2.78	$2,005	$1.35	$974	$2,979
Aluminum Jacket, 0.016"	708	SF	$5.10	$3,613	$0.56	$397	$4,010
Circulating Pump: 1/8 HP	1	EA	$102	$102	$464.42	$464	$566
Thermostatic Pump Control, DDC	1	EA	$41.58	$42	$215.11	$215	$257
Wiring & Conduit	50	LF	$5.16	$258	$1.90	$95	$353
Motor Starter (Mechanical Room)	1	EA	$83	$83	$94	$94	$177
Subtotal Bldg 117-5 Run Around Loop				$13,344		$11,739	$25,083
Nevada Sales Tax	3.75%	%		-		$440	$440
Subtotal							$25,523
Contractor OH & Profit	25.0%	%					$6,381
Subtotal							$31,904
Bond	1.5%	%					$479
Subtotal							$32,383
Estimating Contingency	10.0%	%					$3,238
Total Probable Construction Cost - Building 117-5 Run Around Loop							**$35,621**

CONSTRUCTION COST ESTIMATE					Date Prepared March-95		Sheet 2 of 2
Project ECIP Facility Energy Improvements				Project No.	Basis for Estimate		
Location Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada					Code A (no design competed)		
Engineer-Architect Keller & Gannon							
Drawing No. Exhaust Air Heat Recovery Retrofit			Estimator B. I. Horst		Checked By R. C. Lennig		
Line Item	Quantity		Labor		Material		Total
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Cost
Building 117-6 Steamout Building - Exhaust Air Heat Recovery - Run-Around Loop							
Exhst Coil: 24" x 48", 3/8" x 0.016" Tube, 0.0065 Al, 2 Row, 8 Fin/Inch	14	EA	$311	$4,348	$649	$9,092	$13,440
Exhst Coil: 16" x 16", 3/8" x 0.016" Tube, 0.0065 Al, 2 Row, 8 Fin/Inch	8	EA	$69	$554	$366	$2,926	$3,480
SA Coil: 42.5" x 105", 1/2" x 0.017" Tube, 0.0065 Al, 2 Row, 8 Fin/Inch	2	EA	$1,196	$2,393	$1,279	$2,557	$4,950
Copper Pipe, 3/4", Type K, including 10% allowance for fittings	1,300	LF	$4.36	$5,669	$2.72	$3,531	$9,200
Fiberglass Insulation, 1-1/2" Wall, 3/4" Pipe, All Service Jacket	1,300	LF	$2.78	$3,613	$1.35	$1,755	$5,368
Aluminum Jacket, 0.016"	1,276	SF	$5.10	$6,510	$0.56	$716	$7,226
Circulating Pump: 1/8 HP	2	EA	$102	$203	$464.42	$929	$1,132
Thermostatic Pump Control, DDC	2	EA	$41.58	$83	$215.11	$430	$513
Wiring & Conduit	80	LF	$5.16	$412	$1.90	$152	$564
Motor Starter (Mechanical Room)	2	EA	$83	$166	$94	$188	$354
Subtotal Bldg 117-6 Run Around Loops				$23,953		$22,276	$46,228
Nevada Sales Tax	3.75%	%		-		$835	$835
Subtotal							$47,064
Contractor OH & Profit	25.0%	%					$11,766
Subtotal							$58,829
Bond	1.5%	%					$882
Subtotal							$59,712
Estimating Contingency	10.0%	%					$5,971
Total Probable Construction Cost - Building 117-6 Run Around Loop							**$65,683**

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldgs 117-1, 3, 4, 5, 6, 8, 10 & 11 HVAC System DDC Controls Retrofits (Total Project)
Analysis Date: March 1995 Economic Life: 10 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$660,077		
B. SIOH	$ 39,605		
C. Design Cost	$ 39,605		
D. Total Cost (1A+1B+1C)	$ 739,286		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$739,286

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	331		$4,242	8.58	$36,400
B. Dist	$6.13	4,779		$29,286	9.62	$281,734
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	60.8	kW	$6,214	8.58	$53,317
F. Total		5,110		$39,743		$371,451

3. Non Energy Savings (+) or Cost (-):			
A. Annual Recurring (+/-)	42,079		
(1) Discount Factor (Table A)		8.53	
(2) Discounted Savings/Cost (3A x 3A1)			$358,934

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	$566,068	0	1.00	$566,068
b.				
c.				
d. Total	$566,068			$566,068

C Total Non Energy Discounted Savings (3A2+3Bd4)	$925,002	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$138,429	
5. Simple Payback (1G/4):	5.34	Years
6. Total Net Discounted Savings (2F5+3C):	$1,296,453	
7. Savings to Investment Ratio (SIR) 6/1G:	1.75	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-1 HVAC System DDC Controls Retrofit
Analysis Date: March 1995 Economic Life: 10 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$93,849		
B. SIOH	$ 5,631		
C. Design Cost	$ 5,631		
D. Total Cost (1A+1B+1C)	$ 105,111		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$105,111

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	66.1		$848	8.58	$7,273
B. Dist	$6.13	320		$1,959	9.62	$18,848
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	7.6	kW	$777	8.58	$6,665
F. Total		386		$3,584		$32,786

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$5,738		
(1) Discount Factor (Table A)		8.53	
(2) Discounted Savings/Cost (3A x 3A1)			$48,945

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	$82,483	0	1.00	$82,483
b.				
c.				
d. Total	$82,483			$82,483

C Total Non Energy Discounted Savings (3A2+3Bd4)	$131,428	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$17,570	
5. Simple Payback (1G/4):	5.98	Years
6. Total Net Discounted Savings (2F5+3C):	$164,214	
7. Savings to Investment Ratio (SIR) 6/1G:	1.56	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-3 HVAC System DDC Controls Retrofit
Analysis Date: March 1995 Economic Life: 10 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$82,376		
B. SIOH	$ 4,943		
C. Design Cost	$ 4,943		
D. Total Cost (1A+1B+1C)	$ 92,261		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$92,261

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	10.1		$129	8.58	$1,107
B. Dist	$6.13	89.9		$551	9.62	$5,303
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	7.6	kW	$777	8.58	$6,665
F. Total		100.0		$1,457		$13,074

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$5,738		
(1) Discount Factor (Table A)		8.53	
(2) Discounted Savings/Cost (3A x 3A1)			$48,945

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	$76,208	0	1.00	$76,208
b.				
c.				
d. Total	$76,208			$76,208

C Total Non Energy Discounted Savings (3A2+3Bd4)	$125,154	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$14,816	
5. Simple Payback (1G/4):	6.23	Years
6. Total Net Discounted Savings (2F5+3C):	$138,228	
7. Savings to Investment Ratio (SIR) 6/1G:	1.50	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-4 HVAC System DDC Controls Retrofit
Analysis Date: March 1995 Economic Life: 10 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$79,491		
B. SIOH	$ 4,769		
C. Design Cost	$ 4,769		
D. Total Cost (1A+1B+1C)	$ 89,030		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$89,030

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	8.2		$105	8.58	$900
B. Dist	$6.13	47.4		$291	9.62	$2,795
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	7.6	kW	$777	8.58	$6,665
F. Total		55.6		$1,172		$10,359

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$5,738		
(1) Discount Factor (Table A)		8.53	
(2) Discounted Savings/Cost (3A x 3A1)			$48,945

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	$66,958	0	1.00	$66,958
b.				
c.				
d. Total	$66,958			$66,958

C Total Non Energy Discounted Savings (3A2+3Bd4) $115,904

4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$13,606	
5. Simple Payback (1G/4):	6.54	Years
6. Total Net Discounted Savings (2F5+3C):	$126,263	
7. Savings to Investment Ratio (SIR) 6/1G:	1.42	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-5 HVAC System DDC Controls Retrofit
Analysis Date: March 1995 Economic Life: 10 Years Preparer: KELLER & GANNON

1. Investment Costs

A. Construction Costs	$65,621		
B. SIOH	$ 3,937		
C. Design Cost	$ 3,937		
D. Total Cost (1A+1B+1C)	$ 73,496		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$73,496

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	93.3		$1,196	8.58	$10,261
B. Dist	$6.13	1,676		$10,273	9.62	$98,823
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	7.6	kW	$777	8.58	$6,665
F. Total		1,770		$12,245		$115,749

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$3,825		
(1) Discount Factor (Table A)		8.53	
(2) Discounted Savings/Cost (3A x 3A1)			$32,630

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	$55,166	0	1.00	$55,166
b.				
c.				
d. Total	$55,166			$55,166

C Total Non Energy Discounted Savings (3A2+3Bd4) $87,797

4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$21,587	
5. Simple Payback (1G/4):	3.40	Years
6. Total Net Discounted Savings (2F5+3C):	$203,546	
7. Savings to Investment Ratio (SIR) 6/1G:	2.77	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-6 HVAC System DDC Controls Retrofit
Analysis Date: March 1995 Economic Life: 10 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$164,369		
B. SIOH	$ 9,862		
C. Design Cost	$ 9,862		
D. Total Cost (1A+1B+1C)	$ 184,094		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$184,094

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	140.4		$1,800	8.58	$15,448
B. Dist	$6.13	2,560		$15,689	9.62	$150,933
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	15.2	kW	$1,554	8.58	$13,329
F. Total		2,701		$19,043		$179,710

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$9,563		
(1) Discount Factor (Table A)		8.53	
(2) Discounted Savings/Cost (3A x 3A1)			$81,576

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	$138,412	0	1.00	$138,412
b.				
c.				
d. Total	$138,412			$138,412

C Total Non Energy Discounted Savings (3A2+3Bd4)	$219,988	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$42,448	
5. Simple Payback (1G/4):	4.34	Years
6. Total Net Discounted Savings (2F5+3C):	$399,698	
7. Savings to Investment Ratio (SIR) 6/1G:	2.17	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-8 HVAC System DDC Controls Retrofit
Analysis Date: March 1995 Economic Life: 10 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$86,205		
B. SIOH	$ 5,172		
C. Design Cost	$ 5,172		
D. Total Cost (1A+1B+1C)	$ 96,549		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$96,549

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	6.2		$80	8.58	$687
B. Dist	$6.13	52		$318	9.62	$3,059
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	7.6	kW	$777	8.58	$6,665
F. Total		58		$1,175		$10,410

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$5,738		
(1) Discount Factor (Table A)		8.53	
(2) Discounted Savings/Cost (3A x 3A1)			$48,945

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	$72,594	0	1.00	$72,594
b.				
c.				
d. Total	$72,594			$72,594

C Total Non Energy Discounted Savings (3A2+3Bd4) $121,540

4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$14,172	
5. Simple Payback (1G/4):	6.81	Years
6. Total Net Discounted Savings (2F5+3C):	$131,950	
7. Savings to Investment Ratio (SIR) 6/1G:	1.37	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldgs 117-10 & 117-11 HVAC System DDC Controls Retrofits
Analysis Date: March 1995 Economic Life: 10 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$88,164		
B. SIOH	$ 5,290		
C. Design Cost	$ 5,290		
D. Total Cost (1A+1B+1C)	$ 98,744		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$98,744

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	6.6		$84	8.58	$723
B. Dist	$6.13	33		$205	9.62	$1,974
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	7.6	kW	$777	8.58	$6,665
F. Total		40		$1,066		$9,362

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$5,738		
(1) Discount Factor (Table A)		8.53	
(2) Discounted Savings/Cost (3A x 3A1)			$48,945

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	$74,246	0	1.00	$74,246
b.				
c.				
d. Total	$74,246			$74,246

C Total Non Energy Discounted Savings (3A2+3Bd4) $123,192

4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$14,229	
5. Simple Payback (1G/4):	6.94	Years
6. Total Net Discounted Savings (2F5+3C):	$132,553	
7. Savings to Investment Ratio (SIR) 6/1G:	1.34	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldgs 117-5 & 117-6: Install Air Curtains on Roll-Up Doors (Total Project)
Analysis Date: March 1995 Economic Life: 20 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$33,729		
B. SIOH	$ 2,024		
C. Design Cost	$ 2,024		
D. Total Cost (1A+1B+1C)	$ 37,777		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$37,777

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	(94.9)		($1,216)	15.08	($18,341)
B. Dist	$6.13	1,218.2		$7,466	18.57	$138,638
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	(4.95)	kW	($505)	15.08	($7,622)
F. Total		1123.4		$5,744		$112,676

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($41.58)		
(1) Discount Factor (Table A)		14.88	
(2) Discounted Savings/Cost (3A x 3A1)			($619)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.				
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4)	($619)	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$5,702	
5. Simple Payback (1G/4):	6.62	Years
6. Total Net Discounted Savings (2F5+3C):	$112,057	
7. Savings to Investment Ratio (SIR) 6/1G:	2.97	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-5: Install Air Curtains on Roll-Up Doors
Analysis Date: March 1995 Economic Life: 20 Years Preparer: KELLER & GANNON

1. Investment Costs

A. Construction Costs	$19,740		
B. SIOH	$ 1,184		
C. Design Cost	$ 1,184		
D. Total Cost (1A+1B+1C)	$ 22,109		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$22,109

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	(39.3)		($503)	15.08	($7,593)
B. Dist	$6.13	504.3		$3,091	18.57	$57,393
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	(2.97)	kW	($303)	15.08	($4,573)
F. Total		465.0		$2,284		$45,227

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($21)		
(1) Discount Factor (Table A)		14.88	
(2) Discounted Savings/Cost (3A x 3A1)			($309)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.				
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4) ($309)

4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$2,263	
5. Simple Payback (1G/4):	9.77	Years
6. Total Net Discounted Savings (2F5+3C):	$44,918	
7. Savings to Investment Ratio (SIR) 6/1G:	2.03	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-6: Install Air Curtains on Roll-Up Doors
Analysis Date: March 1995 Economic Life: 20 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$13,989		
B. SIOH	$ 839		
C. Design Cost	$ 839		
D. Total Cost (1A+1B+1C)	$ 15,668		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$15,668

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	(55.6)		($713)	15.08	($10,748)
B. Dist	$6.13	713.9		$4,375	18.57	$81,245
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	(1.98)	kW	($202)	15.08	($3,049)
F. Total		658.3		$3,460		$67,449

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($21)		
(1) Discount Factor (Table A)		14.88	
(2) Discounted Savings/Cost (3A x 3A1)			($309)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.				
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4) ($309)

4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$3,439	
5. Simple Payback (1G/4):	4.56	Years
6. Total Net Discounted Savings (2F5+3C):	$67,139	
7. Savings to Investment Ratio (SIR) 6/1G:	4.29	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-5 & 117-6: Install Exhaust Air Heat Recovery Run Around Loop (Total Project)
Analysis Date: March 1995 Economic Life: 20 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$101,304		
B. SIOH	$ 6,078		
C. Design Cost	$ 6,078		
D. Total Cost (1A+1B+1C)	$ 113,461		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$113,461

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	12.8		$165	15.08	$2,483
B. Dist	$6.13	3,997.0		$24,495	18.57	$454,872
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	(0.28)	kW	($29)	15.08	($431)
F. Total		4,009.9		$24,631		$456,924

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($2,032)		
(1) Discount Factor (Table A)		14.88	
(2) Discounted Savings/Cost (3A x 3A1)			($30,234)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.				
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4)	($30,234)	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$22,599	
5. Simple Payback (1G/4):	5.02	Years
6. Total Net Discounted Savings (2F5+3C):	$426,690	
7. Savings to Investment Ratio (SIR) 6/1G:	3.76	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-5: Install Exhaust Air Heat Recovery Run Around Loop
Analysis Date: March 1995 Economic Life: 20 Years Preparer: KELLER & GANNON

1. Investment Costs

A. Construction Costs	$35,621		
B. SIOH	$ 2,137		
C. Design Cost	$ 2,137		
D. Total Cost (1A+1B+1C)	$ 39,896		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$39,896

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	6.0		$77	15.08	$1,164
B. Dist	$6.13	1,511		$9,262	18.57	$171,992
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	(0.09)	kW	($10)	15.08	($144)
F. Total		1,517		$9,329		$173,012

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($677)		
(1) Discount Factor (Table A)		14.88	
(2) Discounted Savings/Cost (3A x 3A1)			($10,078)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.				
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4)	($10,078)	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$8,652	
5. Simple Payback (1G/4):	4.61	Years
6. Total Net Discounted Savings (2F5+3C):	$162,934	
7. Savings to Investment Ratio (SIR) 6/1G:	4.08	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Bldg 117-6: Install Exhaust Air Heat Recovery Run Around Loop
Analysis Date: March 1995 Economic Life: 20 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$65,683		
B. SIOH	$ 3,941		
C. Design Cost	$ 3,941		
D. Total Cost (1A+1B+1C)	$ 73,565		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$73,565

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	6.8		$87	15.08	$1,319
B. Dist	$6.13	2,486		$15,233	18.57	$282,880
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	(0.19)	kW	($19)	15.08	($287)
F. Total		2,493		$15,302		$283,912

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($1,355)		
(1) Discount Factor (Table A)		14.88	
(2) Discounted Savings/Cost (3A x 3A1)			($20,156)

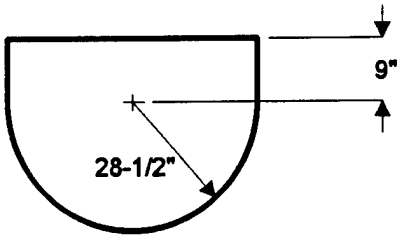
B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.				
b.				
c.				
d. Total	$0			$0

C Total Non Energy Discounted Savings (3A2+3Bd4)	($20,156)
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$13,947
5. Simple Payback (1G/4):	5.27 Years
6. Total Net Discounted Savings (2F5+3C):	$263,756
7. Savings to Investment Ratio (SIR) 6/1G:	3.59

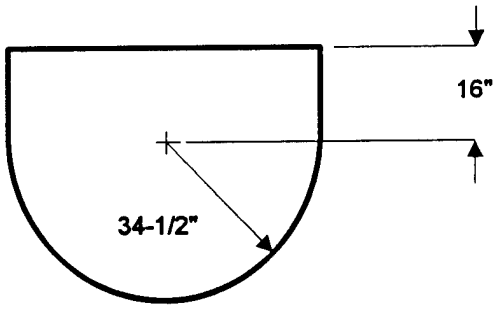
Buildings 117-5 & 117-6 Melt Kettle & Separation Tank Insulation Repairs - Detailed Calculations

Insulation is falling off the melt kettles in buildings 117-5 and 117-6 and from the separation tank in Building 117-6. Existing insulation does not appear to be asbestos containing, and was installed in the mid-1970s, after regulations prohibiting its use were in force. These vessels are steam kettles with hemispherical bottom and cylindrical sides. Dimensions of each are shown on the diagrams below.



Melt Kettles, 2 Each in Buildings 117-5 & 117-6
Insulation on kettle tops is in adequate condition, insulation on the sides and bottoms is falling off.

Insulation repair area each =	46.6	SF
Total insulation repair area =	186.5	SF
Design steam load:	10	Lbs per Hour Each
Total steam load:	40	Lbs per Hour



Separation Tank, 1 in Building 117-6
Insulation on tank top is in adequate condition, insulation on the sides and bottoms is falling off.

Total insulation repair area =	76.0	SF
Design steam load:	20	Lbs per Hour

Each of these vessels is fitted with a steam jacket which receives 15 psig steam. The temperature of 15 psig steam is: 250 °F; ambient temperature in the work room (towers) where the vessels are located is about: 75 °F. The temperature difference is, thus: 175 °F

Heat losses to the air from bare and insulated surfaces at the above temperature difference:

	Bare		2" Insulation	
Horizontal surface, facing downwards:	2.252	BTUH per SF-°FΔT	0.24	BTUH per SF-°FΔT
Vertical surface:	2.580	BTUH per SF-°FΔT	0.24	BTUH per SF-°FΔT

Assume the cylindrical sides of the vessels loose heat at the "vertical surface" rate and that the hemispherical sections loose heat at the average of these two heat loss rates. Then, for bare, uninsulated, vessels, heat loss rates are:

	Bare		2" Insulation	
Melt Kettles:	20,038	BTUH from each Melt Kettle	1,959	BTUH from each Melt Kettle
	80,151	BTUH from 4 Melt Kettles	7,834	BTUH from 4 Melt Kettles
Separation Tank:	32,833	BTUH from the Separation Tank	3,193	BTUH from the Separation Tank
Total "Bare" Losses	112,983	BTUH Total "Insulated" Loss	11,027	BTUH

Repairing the insulation on these vessels, then, is estimated to save about 101,956 BTUH overall.

Assuming an operating schedule for the melt kettles and separation tank of 16 hours per day, 6 days per week, the annual steam load savings is estimated at: 509.0 Million BTU per year load savings.

Steam plant efficiency improvement and energy saving projects are evaluated above.
Steam plant efficiency after implementation of recommended projects is estimated at: 71.4%
No. 2 Fuel Oil savings based on this efficiency and the above load savings is: 713 Million BTU/Year.

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Repair Buildings 117-5 and 117-6 Melt Kettle and Separation Tank Insulation
Analysis Date: March 1995 Economic Life: 15 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$5,275		
B. SIOH	$ 316		
C. Design Cost	$ 316		
D. Total Cost (1A+1B+1C)	$ 5,907		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$5,907

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82			$0	12.02	$0
B. Dist	$6.13	712.8		$4,368	14.23	$62,164
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21		kW	$0	12.02	$0
F. Total		712.8		$4,368		$62,164

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	($5,275)	5	0.863	($4,552)
b.	($5,275)	10	0.744	($3,924)
c.				
d. Total	($10,549)			($8,476)

C Total Non Energy Discounted Savings (3A2+3Bd4)	($8,476)	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$3,665	
5. Simple Payback (1G/4):	1.61	Years
6. Total Net Discounted Savings (2F5+3C):	$53,687	
7. Savings to Investment Ratio (SIR) 6/1G:	9.09	

CONSTRUCTION COST ESTIMATE					Date Prepared March-95		Sheet 1 of 1
Project ECIP Facility Energy Improvements					Project No.	Basis for Estimate	
Location Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada						Code A (no design competed)	
Engineer-Architect Keller & Gannon							
Drawing No. **Repair Melt Kettle & Separation Tank Insulation**		Estimator B. I. Horst				Checked By R. C. Lennig	
Line Item	Quantity		Labor		Material		Total
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Cost
Buildings 117-5 & 117-6 Melt Kettle and Separation Tank Insulation Repairs							
Remove Existing Deteriorated Blanket Insulation from Vessels	263	SF	$4.11	$1,078	$0.00	$0	$1,078
Fix Metal Insulation Tabs to Vessels, One per SF to Retain Insulation	263	EA	$3.25	$852	$1.00	$263	$1,115
Blanket Type Fiberglass Insulation, 2-Inch Thick, 1-1/2 LB/SF Density	315	SF	$4.05	$1,276	$0.92	$290	$1,566
Subtotal				$3,206		$552	$3,759
Nevada Sales Tax	3.75%	%		-		$21	$21
Subtotal							$3,779
Contractor OH & Profit	25.0%	%					$945
Subtotal							$4,724
Bond	1.5%	%					$71
Subtotal							$4,795
Estimating Contingency	10.0%	%					$480
Total Probable Construction Cost							**$5,275**

Melt Kettle and Separation Tank insulation is subject to exposure to steam throughout its useful life. The existing installation has been operating only a couple of years and has deteriorated rapidly. Assume that insulation must be replaced every 5 years. **$5,275** each 5 years.

Compressed Air System Modifications - Detailed Calculations

Compressed air is provided from the central plant, Building 117-2, to WADF facilities. Three air compressors are connected in parallel to the distribution system which is partly above and partly below ground. The system is shown schematically on Figure 3.

Existing compressors are deteriorated; in fact, only one was operational at the time of field investigations. Run-time meters installed on each compressor indicate that the systems have been operated for only a fraction of their ages. The following data were observed:

Air Compressor 1	9,893 Hours, total run-time	18 years old
Air Compressor 2	10,999 Hours, total run-time	18 years old
Air Compressor 3	19,122 Hours, total run-time	18 years old

Much higher run times are expected for 18-year old machines; on the order of 50,000 total hours or more.

Compressed air from the central plant, Plant Air, is distributed to WADF buildings at about 115 psig. Plant Air is used as motive force in HVAC system damper actuators and for process uses.

In most mechanical rooms, Plant Air and instrument air systems have been interconnected. This was done to retain control in the event of a central plant shutdown; however, interconnections have remained open. This has lead to contamination of sensors and controls which are not designed for even the small amounts of oil found in Plant Air. System interconnections should be removed. HVAC control system retrofit calculations provided in above assume replacement of existing pneumatic control systems with DDC controls, effectively eliminating the need for instrument compressed air service. Plant Air is still required to provide motive force for damper actuators and other control devices.

Existing air compressors are in need of complete overhauls. Replacement of the existing air compressors and ancillary equipment (oil and air coolers and refrigerated air dryers) should be considered.

Based on manufacturers catalog data, performance of the existing plant air compressors is as follows:

Compressor Nameplate Data:

Ingersoll-Rand Model:	PA150	S/N:	96076U76859
Motor:	200 HP		
Operating. Pressure:	115 psig		
Full Load Capacity at 100 psig:	680 Actual Cubic Feet per Minute (ACFM)		
Full Load BHP at 100 psig:	150 BHP		
Compressor Efficiency:	22.06 BHP/100ACFM		
Motor Efficiency:	92.5%		

Compressor Power Consumption Measurement:		96%	PF
(Averages of three measurements)		135.3	RLA
		484	Volts, 3 Phase
	680 CFM	108.9	kW based on measurement
	680 CFM	121.0	kW based on nameplate data

Refrigerated Air Dryer One air dryer is installed, as shown on Figure 3, for each air compressor.

Nameplate Data: Ingersoll-Rand Model No. MN 14, S/N: 14D0576002, 3 and 4

Model 14 performance data is not available, however, Ingersoll-Rand Model Nos. 11 & 12 performance is:

Model 11: 575 CFM @ 440 VAC 11.0 A 0.96 PF =		8.05	kW, or
	Model 11	1.40	kW / 100 SCFM
Model 12: 700 CFM @ 440 VAC 13.5 A 0.96 PF =		9.88	kW, or
	Model 12	1.41	kW / 100 SCFM
Assume Model 14 has the same performance:		1.40	kW / 100 SCFM
Thus, at 680 CFM, the electrical demand is:		9.5	kW

SCFM = Standard Cubic Feet per Minute

Operating Problems:

Operators at Building 117-6 state that when sludge presses at 117-6 & 117-7 are dumped, the air pressure at Buildings 117-5 & 117-8 drops. All systems except manipulators run at 15 psig. Manipulators at building 117-5 & 117-8 require at least 80 psig compressed air to operate.

Significant plant air leaks were found at Building 117-6 (oil separator glass broken) and at Building 117-11 (top of the conveyor hopper from Building 117-10). Overall, leaks appear to constitute a hole of about 3/8" in diameter. The leakage rate is calculated as follows:

Mass Flow Rate Calculation:

For air; R = 53.3 Ft/°R & k = 1.4

P = 105 psig & T = 85 °F

p_1 / RT_1 = (105 + 14.7) psig x 144 in^2/SF ÷ (53.3 x (460 + 85)) = 0.5934 lf/ft^3

Critical $(p_2 / p_1) = (2 / (k + 1))^{k/(k-1)} = (2.0 / 2.4)^{1.40 / 0.40}$ = 0.528

Ratio (atmosphere / system pressure) = 14.7 / 119.7 = 0.123

Since this latter ratio is less than the critical pressure ratio, the pressure of the escaping gas = 0.528 x p_1. Hence p_2 = 0.528 x 119.7 = 63.2 psia

$V_2 = c_2$ = Square Root (1.4 x 32.2 x 53.3 x T_2) = Square Root (2402.764 T_2)

where $T_2/T_1 = (p_2/p_1)^{(k-1)/k} = (0.528)^{0.40 / 1.40}$ = 0.833 , then T_2 = 454 °R

Then V_2 = Square Root (2402.764 x 454) = 1,045 Ft/Sec

Volumetric flow rate: 192 ACFM at -6°F, the capacity of the air compressor.
224 SCFM

This air leakage rate, 192 ACFM is 28.3% of a single air compressor's capacity, and is probably the reason for the operating problems addressed above.

Present Compressed Air System Power Consumption

Without considering process compressed air consumption, the air leakage rate calculated above consumes: 195,588 kWH per year of electric power. Calculated as follows:

(Measured Compressor kW + Refrigerated Air Dryer kW) x (% of Compressor Capacity Devoted to Leaks) x Hours per Year of Operation

Process compressed air consumption is assumed to require operation of compressors for 5 additional hours per day now, constituting about 184,756 kWH per year of additional power consumption, for a total 380,345 kWH per year of compressed air system power use.

Estimates for future use are based on 2 compressors operating 8 hours per day 6 days per week. The longer operating hours per day allow for operation of WADF at closer to its capacity.

Proposed Compressed Air System Repairs and Energy Saving Options

Energy Saving Opportunities

Proposed energy conservation opportunities for the compressed air system included suggestions to lower the compressed air pressure and increase storage volume. Neither approach is technically feasible at WADF. Manipulators in the Refining and Mechanical Removal buildings require at least 80 psig; the pressure must be maintained high enough at the central plant (building 117-2) in order to provide the required pressure at the point of use (building 117-8), farthest from the plant. Storage volume could be increased, however, this would only result in reducing cycle frequency for the system, a problem that should be cleared up by fixing air leaks.

Repairs Required

Existing air compressors need rebuilding and renovation due to their inactivation for a number of years. Two of the three air compressors are currently undergoing repairs, and are partially disassembled. It is assumed that all three existing compressors require "air-end" rebuilds and control system renovations. Based on discussions with an Ingersoll-Rand representative, budget cost for such a rebuild can be expected to require $8,000 to $10,000 for the air-end rebuild with an additional $2,000 to $3,000 for on-site labor and materials for installation and control system renovation. Bare cost per unit for air-end rebuilds and control system repairs is, thus: $13,000 ; total for 3 units is = $39,000

Repairs are required for the Building 117-6 oil separator glass and the Building 117-11 conveyor hopper air valve to stop air leaks which presently constitute the largest compressed air load on the system.

Repairing leaks alone will save about: 195,588 kWH per year $8,558 per year savings

The following proposed system modifications are considered assuming this renovation & repair expense is avoided.

Replacement Options for Air Compressors and Air Dryers

The existing PA150 air compressors are rated to produce 680 ACFM at 19.19 kW / 100 ACFM. Three compressors are installed, two operating and one spare. A single compressor currently carries the load, however, most of the WADF buildings are not presently operating. Replacement options consider providing the same capacity of compressed air service as was originally installed.

Alternative 1: Replace Existing System with Ingersoll-Rand Model SSR XFE300-2S and Desiccant Air Dryer

Capacity ,thus, performance of the proposed air compressor is reduced by 15% for the desiccant air dryer. A desiccant air dryer requires about 15% of the compressor output for regeneration of the desiccant. Desiccant air dryers are available with only about 7% purge requirements; however, electric heating elements are installed to compensate for the reduced compressed air supply.

Presently, two PA150 air compressors can provide about 1,360 ACFM of 100 psig air. Allowing for the loss of 15% of the capacity for use in desiccant air dryers, about 1,600 ACFM at 100 psig is required. Based on catalog data, an Ingersoll-Rand two stage rotary screw air compressor, model number SSR XFE300-2S, is selected as a replacement air compressor.

Operating parameters are: 1,602 ACFM at 100 psig, one 300 HP Motor of 95.2% efficiency
Modern controls allow air volume provided to modulate with demand.

A desiccant air dryer is provided to replace the existing refrigerated air dryers. The desiccant dryer uses essentially no power, relying on compressed air for desiccant recharging. Two desiccant columns are provided to allow one in operation while the other is being recharged.

The rotary screw air compressor is air cooled. Costs are allowed for ducting fresh outside air into and out of the air compressor for cooling purposes. This allows the existing air/oil coolers located outside building 117-2 to be removed from service.

Energy savings and economic analysis results are summarized on Table 6. Costs associated with this proposed retrofit include: Cost of the new air compressor and desiccant air dryer, ductwork required for cooling air and avoided costs of repairing the three existing air compressors and refrigerated air dryer sets. Backup compressed air service is assumed available from instrument air compressors located in each of the WADF building mechanical rooms.

Alternative 2: Replace Existing System with Ingersoll-Rand Model SSR XFE250-2S, use Existing Refrigerated Air Dryers

This alternative is similar to Alternative 1 presented above, except existing refrigerated air dryers are to be retained in service rather than installing desiccant air dryers. Because the desiccant air dryers are not to be installed, the compressor need not have as high a capacity. Consequently, an Ingersoll-Rand Two-Stage Rotary Screw Air Compressor, Model SSR XFE250-2S is selected.

Operating parameters are: 1,355 ACFM at 100 psig, one 250 HP Motor of 95.2% efficiency
Modern controls allow air volume provided to modulate with demand.

Energy savings and economic analysis results are summarized on Table 6. Costs associated with this proposed retrofit include: Cost of the new air compressor and repair or replacement of the existing refrigerated air dryers and avoided costs of repairing the three existing air compressors. Backup compressed air service is assumed available from instrument air compressors located in each of the WADF building mechanical rooms. These compressors are currently interconnected with the Plant Air system and will be deenergized as a result of DDC control retrofits proposed for building HVAC systems.

Alternative 3: Replace Existing System with Two Ingersoll-Rand Model LL5 and Desiccant Air Dryer

This proposed replacement option is similar to the Alternative 1 described above. It is proposed to replace the three existing Ingersoll-Rand PA 150 air compressors with two Ingersoll-Rand LL5 reciprocating air compressors and desiccant air dryers. The LL5 line of air compressors is water cooled, thus, a cooling water system is required for each of the air compressors.

Operating parameters are: Two LL5 Reciprocating, Water Cooled Air Compressors, each delivering 810 ACFM at 100 psig, one 150 HP Motor each of 92.5% efficiency.

The desiccant air dryer requires 15% of the compressed air produced, thus, the compressors are oversized to allow for desiccant regeneration. The existing air/oil coolers located outside building 117-2 are removed from service.

Energy savings and economic analysis results are summarized on Table 6. Costs associated with this proposed retrofit include: Cost of the new air compressors and desiccant air dryers and avoided costs of repairing the three existing air compressors and refrigerated air dryer sets. Backup compressed air service is assumed available from instrument air compressors located in each of the WADF building mechanical rooms. These compressors are currently interconnected with the Plant Air system and will be deenergized as a result of DDC control retrofits proposed for building HVAC systems.

Alternative 4: Replace Existing System with Ingersoll-Rand Model LL5 Reciprocating Air Compressors, use Existing Refrigerated Air Dryers

This alternative is similar to Alternative 3, the LL5 air compressor alternative presented above, except existing refrigerated air dryers are to be retained in service; desiccant air dryers are not to be installed. Because the desiccant air dryers are not to be installed, the replacement compressors need not have as high capacities. Consequently, two 125 HP Ingersoll-Rand LL5 reciprocating air compressors are selected. The LL5 line of air compressors is water cooled, thus, a cooling water system is required for each of the air compressors.

Operating parameters are: Two LL5 Reciprocating, Water Cooled Air Compressors, each delivering 634 ACFM at 100 psig, one 125 HP Motor each of 92.5% efficiency.

Energy savings and economic analysis results are summarized on Table 6. Costs associated with this proposed retrofit include: Cost of the new air compressors and repair or replacement of the existing refrigerated air dryers and avoided costs of repairing the three existing air compressors. Backup compressed air service is assumed available from instrument air compressors located in each of the WADF building mechanical rooms. These compressors are currently interconnected with the Plant Air system and will be deenergized as a result of DDC control retrofits proposed for building HVAC systems.

Figure 3
Western Area Demilitarization Facility
Compressed Air Distribution System Schematic Diagram

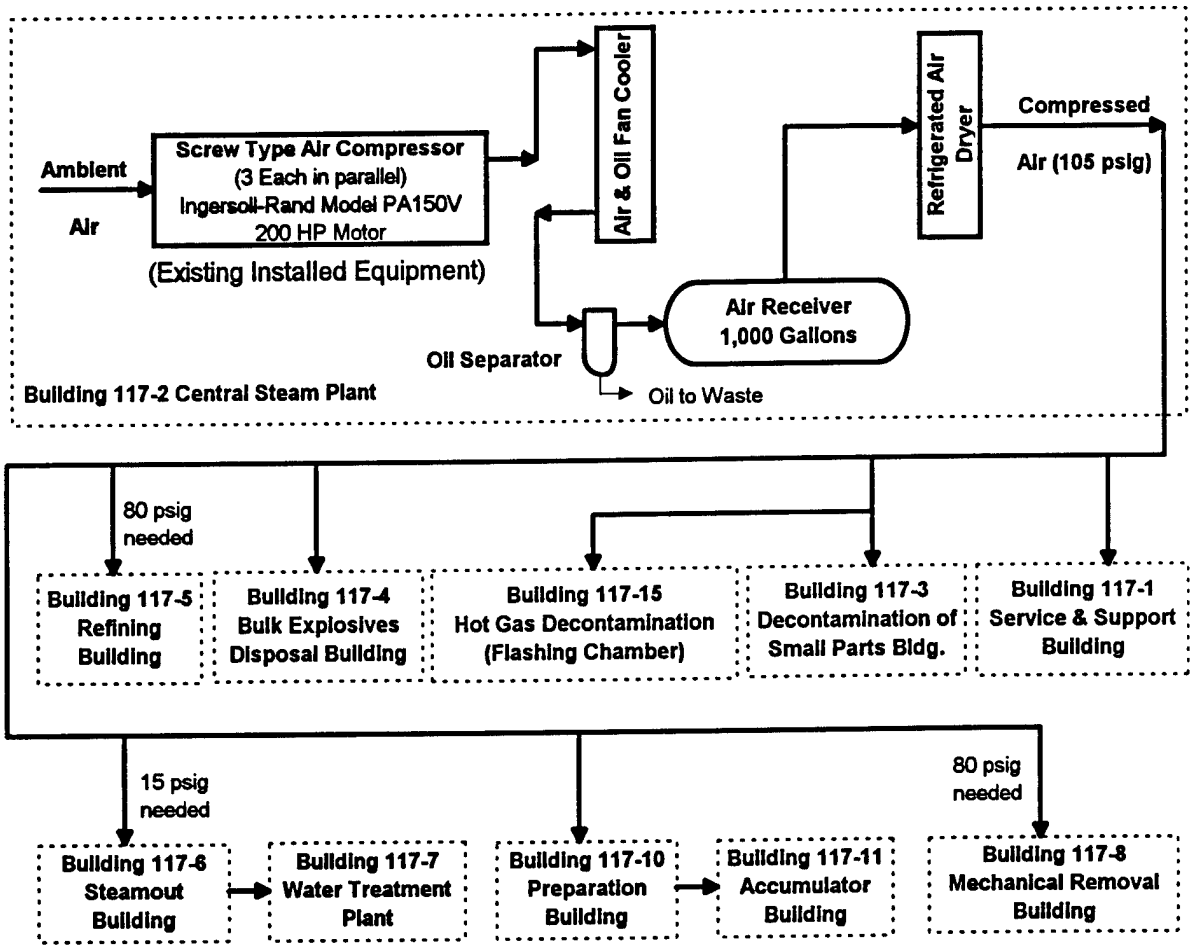


Table 6. Summary of Air Compressor Retrofit Alternative Evaluations

Compressor & Air Dryer Description	Capacity ACFM	Connected kW	Eq. Hours per Year	Power kWH/Yr	kW Saved	kWH/Yr Saved	Elec Saved $/Year	LCC$ Saved	Investment $	SIR
Existing Installation: (values indicated based on 2 operating, 1 standby)								Assumed		
3 x I-R PA150 Air Compressors, and	1,360	242	1,662	441,308	-	-	-	20 Year	-	-
3 x I-R MN14 Refrigerated Air Dryers	Total	19		195,588				Compressor		
3 x Aftercooler / Oil Cooler (Exterior)		4.5	See Note 1	See Note2				Lifetime		
Alternative 1: Replacement I-R MN SSR XFE300-2S and Desiccant Air Dryer										
1 x I-R SSR XFE300-2S Compressor	1,602	224	1,660	371,566	41.7	265,330	$15,868	$239,297	$182,761	1.63
1 x Desiccant Air Dryer (requires 15% of compressor output for regeneration)									Payback Years =	10.04
Alternative 2: Replacement I-R SSR XFE250-2S with Existing Refrigerated Air Dryers										
1 x I-R SSR XFE250-2S Compressor	1,355	187	1,668	342,937	59.9	293,959	$18,987	$286,329	$166,795	1.86
2 x I-R MN14 Extg. Refr. Air Dryers	Total	19							Payback Years =	8.52
Alternative 3: Replacement I-R MN LL5 and Desiccant Air Dryer										
2 x I-R LL5 Air Compressors 150 HP	1,620	224	1,642	379,686	34.2	257,211	$14,751	$222,442	$235,684	1.15
2 x Cooling Systems (Water Cooling)		7							Payback Years =	14.40
2 x Desiccant Air Dryers (require 15% of compressor outputs for regeneration)										
Alternative 4: Replacement I-R MN LL5 with Existing Refrigerated Air Dryers										
2 x I-R LL5 Air Compressors 125 HP	1,268	187	1,783	379,768	48.0	257,129	$16,156	$243,632	$240,202	1.05
2 x Cooling Systems (Water Cooling)		7							Payback Years =	15.24
2 x I-R MN14 Extg. Refr. Air Dryers	Total	19								

Note 1: Operating hours per year assume that the air compressors are operating 33% of the scheduled WADF operating hours (16 hours/day, 6 days/week). Operating hours for proposed replacement options are adjusted to provide the same amount of compressed air as the existing PA 150 compressors.

Note 2: Power consumption due to leaks in the existing system is added to the "base case" and repair costs are expensed for each alternative.

Recommended Option: **Replace air compressors with Ingersoll-Rand Model SSR XFE250-2S 2-stage rotary screw air compressor, use existing refrigerated air dryers**

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Replace Air Compressors with Ingersoll-Rand Model SSR XFE250-2S 2-Stage Rotary Screw Air Compressor; Use Existing Air Dryers (Alt. 2, Recommended)
Analysis Date: March 1995 Economic Life: 20 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$148,924		
B. SIOH	$ 8,935		
C. Design Cost	$ 8,935		
D. Total Cost (1A + 1B + 1C)	$ 166,795		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$166,795

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	1,003		$12,862	15.08	$193,954
B. Dist	$6.13			$0	18.57	$0
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	59.9	kW	$6,126	15.08	$92,375
F. Total		1,003		$18,987		$286,329

3. Non Energy Savings (+) or Cost (-):			
A. Annual Recurring (+/-)	($2,234)		
(1) Discount Factor (Table A)		14.88	
(2) Discounted Savings/Cost (3A x 3A1)			($33,240)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-) (4)
a.	$56,470	0	1.000	$56,470
b.				
c.				
d. Total	$56,470			$56,470

C Total Non Energy Discounted Savings (3A2 + 3Bd4)	$23,231	
4. First Year Dollar Savings (2F3 + 3A + (3Bd1/Years Economic Life)):	$19,577	
5. Simple Payback (1G/4):	8.52	Years
6. Total Net Discounted Savings (2F5 + 3C):	$309,560	
7. Savings to Investment Ratio (SIR) 6/1G:	1.86	

CONSTRUCTION COST ESTIMATE					Date Prepared March-95		Sheet 1 of 1
Project ECIP Facility Energy Improvements				Project No.	Basis for Estimate		
Location Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada					Code A (no design competed)		
Engineer-Architect Keller & Gannon							
Drawing No.		Estimator BIH			Checked By RCL		
Line Item	Quantity		Labor		Material		Total
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Cost
Repair / Rebuild Costs for Both Compressors and Refrigerated Air Dryers							
Ingersoll-Rand PA150 Compressor Air-End Rebuild	3	EA	Included		$10,000	$30,000	$30,000
Replace/Repair Refrigerated Air Dryers, Ingersoll-Rand MN14	3	EA	Included		$8,991	$26,974	$26,974
Ingersoll-Rand PA150 Compressor Controls Repairs & Renovation	3	EA	Included		$3,000	$9,000	$9,000
Subtotal			Included			$65,974	$65,974
Nevada Sales Tax	3.75%	%		-		$2,474	$2,474
Subtotal							$68,448
Contractor OH & Profit	25.0%	%					$17,112
Subtotal							$85,560
Bond	1.5%	%					$1,283
Subtotal							$86,844
Estimating Contingency	10.0%	%					$8,684
Total Probable Construction Cost							**$95,528**
Repair / Rebuild Costs for Air Compressors Only							
Ingersoll-Rand PA150 Compressor Air-End Rebuild	3	EA	Included		$10,000	$30,000	$30,000
Ingersoll-Rand PA150 Compressor Controls Repairs & Renovation	3	EA	Included		$3,000	$9,000	$9,000
Subtotal			Included			$39,000	$39,000
Nevada Sales Tax	3.75%	%		-		$1,463	$1,463
Subtotal							$40,463
Contractor OH & Profit	25.0%	%					$10,116
Subtotal							$50,578
Bond	1.5%	%					$759
Subtotal							$51,337
Estimating Contingency	10.0%	%					$5,134
Total Probable Construction Cost							**$56,470**

CONSTRUCTION COST ESTIMATE					Date Prepared March-95		Sheet 1 of 2
Project: ECIP Facility Energy Improvements					Project No.	Basis for Estimate: Code A (no design competed)	
Location: Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada							
Engineer-Architect: Keller & Gannon							
Drawing No. Compressed Air System Replacement with SSR Compressor			Estimator: B. I. Horst			Checked By: R. C. Lennig	
Line Item	Quantity		Labor			Material	Total Cost
	No. Units	Unit Meas.	Per Unit	Total		Per Unit / Total	
Alternative 1: Replacement SSR XFE300-2S Air Cooled Air Compressor & Desiccant Air Dryer							
Ingersoll-Rand SSR XFE300-2S Two Stage Rotary Screw Air Compressor	1	EA	$4,282	$4,282	$85,000	$85,000	$89,282
Heatless Desiccant Air Dryer, Ingersoll Rand HRD60 (1700 CFM)	1	EA	$761.84	$762	$18,390	$18,390	$19,152
Cooling Air Supply and Exhaust Ductwork thru Building Wall	1	Job	$2,678	$2,678	$1,500	$1,500	$4,178
Repair of Compressed Air Leaks	1	Job	$169	$169	$200	$200	$369
Subtotal				$7,891		$105,090	$112,981
Nevada Sales Tax	3.75%	%		-		$3,941	$3,941
Subtotal							$116,922
Contractor OH & Profit	25.0%	%					$29,231
Subtotal							$146,153
Bond	1.5%	%					$2,192
Subtotal							$148,345
Estimating Contingency	10.0%	%					$14,835
Total Probable Construction Cost							**$163,180**
Alternative 2: Replacement SSR XFE300-2S Air Cooled Air Compressor & Desiccant Air Dryer							
Ingersoll-Rand SSR XFE250-2S Two Stage Rotary Screw Air Compressor	1	EA	$4,040	$4,040	$68,000	$68,000	$72,040
Replace/Repair Refrigerated Air Dryers, Ingersoll-Rand MN14 or equal	3	EA	Included		$8,991	$26,974	$26,974
Cooling Air Supply and Exhaust Ductwork thru Building Wall	1	Job	$2,510	$2,510	$1,200	$1,200	$3,710
Repair of Compressed Air Leaks	1	Job	$169	$169	$200	$200	$369
Subtotal				$6,719		$96,374	$103,094
Nevada Sales Tax	3.75%	%		-		$3,614	$3,614
Subtotal							$106,708
Contractor OH & Profit	25.0%	%					$26,677
Subtotal							$133,385
Bond	1.5%	%					$2,001
Subtotal							$135,385
Estimating Contingency	10.0%	%					$13,539
Total Probable Construction Cost							**$148,924**

For Life Cycle Cost Analysis, assume existing air compressors and refrigerated air dryer repairs must be performed. These costs are expensed year "0" in the Life Cycle Cost Analysis Summary. **$95,528**

Annual O&M expenses are assumed equal to 1.5% of the construction costs per year:
Option with Desiccant Air Dryers: **$2,448** per year.
Option with existing Refrigerated Air Dryers: **$2,234** per year.

CONSTRUCTION COST ESTIMATE					Date Prepared March-95		Sheet 2 of 2
Project ECIP Facility Energy Improvements					Project No.	Basis for Estimate	
Location Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada						Code A (no design competed)	
Engineer-Architect Keller & Gannon							
Drawing No. Compressed Air System Replacement with LL5 Compressors			Estimator B. I. Horst			Checked By R. C. Lennig	
Line Item	Quantity		Labor		Material		Total
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Cost
Alternative 3: Replacement LL5 Water Cooled Air Compressors & Desiccant Air Dryers							
Ingersoll-Rand LL5 Air Compressor to Replace Existing PA 150 Compressor	2	EA	$6,423	$12,846	$45,000	$90,000	$102,846
Heatless Desiccant Air Dryer, Ingersoll Rand HRD (600 CFM)	2	EA	$304.74	$609	$9,623	$19,246	$19,855
Cooling Water System for I-R LL5 Air Compressor	2	EA	$1,427	$2,855	$10,000	$20,000	$22,855
Repair of Compressed Air Leaks	1	Job	$169	$169	$200	$200	$369
Subtotal				$16,480		$129,446	$145,926
Nevada Sales Tax	3.75%	%		-		$4,854	$4,854
Subtotal							$150,780
Contractor OH & Profit	25.0%	%					$37,695
Subtotal							$188,475
Bond	1.5%	%					$2,827
Subtotal							$191,302
Estimating Contingency	10.0%	%					$19,130
Total Probable Construction Cost							**$210,432**
Alternative 4: Replacement I-R MN LL5 with Existing Refrigerated Air Dryers							
Ingersoll-Rand LL5 Air Compressor to Replace Existing PA 125 Compressor	2	EA	$6,423	$12,846	$42,750	$85,500	$98,346
Cooling Water System for I-R LL5 Air Compressor	2	EA	$1,503	$3,005	$10,000	$20,000	$23,005
Replace/Repair Refrigerated Air Dryers, Ingersoll-Rand MN14	3	EA	Included		$8,991	$26,974	$26,974
Repair of Compressed Air Leaks	1	Job	$169	$169	$200	$200	$369
Subtotal				$16,021		$132,674	$148,695
Nevada Sales Tax	3.75%	%		-		$4,975	$4,975
Subtotal							$153,670
Contractor OH & Profit	25.0%	%					$38,418
Subtotal							$192,088
Bond	1.5%	%					$2,881
Subtotal							$194,969
Estimating Contingency	10.0%	%					$19,497
Total Probable Construction Cost							**$214,466**

For Life Cycle Cost Analysis, assume existing air compressors and refrigerated air dryer repairs must be performed. These costs are expensed year "0" in the Life Cycle Cost Analysis Summary. **$95,528**

Annual O&M expenses are assumed equal to 1.5% of the construction costs per year:
Option with Desiccant Air Dryers: **$3,156** per year.
Option with existing Refrigerated Air Dryers: **$3,217** per year.

High Pressure Water Pump System Retrofits - Detailed Calculations

The high pressure water pump system is housed in Building 117-6A, next to the steamout building. Five (5) high pressure water pumps serve operations in the steamout building. The pumps provide about 13,000 psig water to hydraulic cleaning equipment in building 117-6. Four of the five pumps are normally operated, with one as a spare.

The pumps are positive displacement pumps and are energized whenever the shakeout tables in building 117-6 are operated, about 10 hours per day, 6 days per week.

In order to maintain continuous high pressure water service to the washout lances, the pump discharges are recirculated to pump suctions. This requires all energized pumps to operate at peak load continuously.

Install Variable Frequency Drives to Control High Pressure Water Pump Speeds

A modification to high pressure water pump operation is proposed. Provide variable speed pump control, responding to demand at the washout lances. Variable speed control of the high pressure water pumps will reduce energy consumption, causing the pumps to operate at full load only when required, and will modulate pump speed under lower loads to only that speed needed to maintain water pressure.

High pressure water pump and pump motor nameplate data is as follows:

Pumps, 4 Each: Partec Equipment No. HC17F High Pressure Water Pump
Motor: 150 HP, 20 gpm, DO Pressure: 10,000 psig
Lube Type: O/M
Note: Pump heads have been modified to provide 13,000 psig.

Pump Motors, 1 Each Pump: Toshiba, Model No.: B1504FL F4U3
Frame: 445T, Code 3, NEMA Class F, Design B
150 HP, Class F, Service Factor 1.15
460 VAC, 60 Hz, 1770 RPM, 178 FLA

Pumps heads have been modified from the original design pressure of 10,000 psig to operate at 13,000 psig. Operating load and power consumption measurements made during September 1994 are as follows:

		Amperage			Voltage	Power Factor			Calculated	% Full
Pump No.	Shaft RPM	A	B	C	Measured	A	B	C	kW	Load
1	1,777.6	156	162	164	464	0.83	0.83	0.82	106.7	74.7%
2	1,777.6	154	158	160	464	0.80	0.82	0.85	104.1	74.7%
3	Pump Off	NA	NA	NA	NA	NA	NA	NA	0	NA
4	1,775.8	166	163	169	464	0.82	0.82	0.82	109.4	80.7%
5	1,774.6	170	168	176	464	0.81	0.84	0.82	113.4	84.7%
Total for Operating Pumps (% Full Load is a kW-weighted average)									433.6	78.8%

No washout lances were operating at the time of these measurements, however, it is assumed that the load will remain the same because water is presently recirculated when no lances are operated and is not recirculated when the lances are in use.

Pump kW = Average Amps x Volts x $\sqrt{3}$ x Average Power Factor ÷ 1,000

Percent Full Load = (Synchronous RPM - Measured RPM) ÷ (Synchronous RPM - Full Load RPM)

Annual power consumption, based on operation 10 hours per day, 6 days per week is, thus:
1,352,872 kWH per year, or a cost of $59,193 per year not including electrical demand

charges. Note that the operating schedule used for this calculation assumes WADF is operated at its design capacity, present operations require fewer operating hours per year and fluctuate.

The following load profile is assumed based on observations of steamout building operations and on discussions with shift workers at building 117-6.

% Load	Hr / Day	Pump kW[1]	kWH per Year	
0%	14	Off	0	
10%	3	13.8	12,914	
25%	2	34.5	21,524	
50%	2	69.0	43,048	
75%	2	103.5	64,572	
100%	1	138.0	43,048	
Subtotal	24	-	185,108	per pump (4 each are always operating)
Total, 4 Pumps On			740,430	Total Annual Power Consumption

Note 1:
The efficiency of the Butterworth positive displacement pumps installed in this facility is constant. Load is proportional to flow.

Annual power savings are estimated at: 612,442 kWH / year, 45% of present power usage by the high pressure pumps.

Annual operation and maintenance costs for the high pressure water pumps should be reduced because they are not operated at full capacity for extended periods. No cost benefit is taken for this assumption in order to provide a conservative analysis.

The concept has marginal economic analysis results and is, thus, recommended for implementation. Economic analysis results are summarized below on Table 7.

The above retrofit assumes four pumps are operated during scheduled pump usage. Staged pump control is feasible and could save more energy. However, staged pump control would require cycling the high pressure pumps to follow the load. Motors of the size involved here cannot be cycled at the frequency required without being damaged, thus, pump cycling controls are not considered for this electric motor driven pump installation.

Table 7. Summary of High Pressure Water Pump Drive Retrofit Evaluations

Economic Analysis Parameter	Install VFDs on Existing Motors	
Economic Life (per ECIP guidance):	20	Years
Investment:	$168,767	
Annual Energy Cost Saved:	$26,796	
Annual O&M Cost Saved:	$0	
Annual Non-Recurring Costs Saved:	$0	
Total Annual (First Year) Cost Saved:	$26,796	
Life Cycle Energy Cost Saved:	$404,089	
Life Cycle O&M Cost Saved:	$0	
Life Cycle, Non-Recurring Cost Saved:	$0	
Total Life Cycle Cost Saved:	$404,089	
Savings to Investment Ratio:	2.39	
Payback Period:	6.30	Years

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant Region No. 4 Project No.
Western Area Demilitarization Facility (WADF), Nevada
Project Title: ECIP Facility Energy Improvements Fiscal Year FY96
Install Variable Speed Drives on High Pressure Water Pumps in Building 117-6A
Analysis Date: March 1995 Economic Life: 20 Years Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$150,684		
B. SIOH	$ 9,041		
C. Design Cost	$ 9,041		
D. Total Cost (1A+1B+1C)	$ 168,767		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$168,767

2. Energy Savings (+)/Cost(-):
Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU(1)	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	2,090		$26,796	15.08	$404,089
B. Dist	$6.13			$0	18.57	$0
C. LPG	-	-				
D. Other	-	-				
E. Elec Demand	$102.21	0.0	kW	$0	15.08	$0
F. Total		2,090.3		$26,796		$404,089

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$0		
(1) Discount Factor (Table A)		14.88	
(2) Discounted Savings/Cost (3A x 3A1)			$0

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+) Cost(-)	(4)
a.				$0	
b.				$0	
c.				$0	
d. Total	$0			$0	

C Total Non Energy Discounted Savings (3A2+3Bd4)	$0	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Years Economic Life)):	$26,796	
5. Simple Payback (1G/4):	6.30	Years
6. Total Net Discounted Savings (2F5+3C):	$404,089	
7. Savings to Investment Ratio (SIR) 6/1G:	2.39	

CONSTRUCTION COST ESTIMATE

Date Prepared: March-95	Sheet: 1	of: 1	
Project: ECIP Facility Energy Improvements	Project No.	Basis for Estimate: Code A (no design competed)	
Location: Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada			
Engineer-Architect: Keller & Gannon			
Drawing No.	Estimator: BIH	Checked By: RCL	

Line Item	Quantity: No. Units	Quantity: Unit Meas.	Labor: Per Unit	Labor: Total	Material: Per Unit	Material: Total	Total Cost
Building 117-6A: Install Variable Speed Drives to Control High Pressure Water Pumps							
Install ABB Model ACH-500 Variable Frequency Drives on 150HP Motors	5	EA	$1,500	$7,500	$18,700	$93,500	$101,000
Differential Pressure Controller to Modulate Pump Speed	1	EA	$165	$165	$350	$350	$515
Pressure Sensor, Electric Operated	1	EA	$60.85	$61	$518.56	$519	$579
Conduit and Wiring Allowance	1	Job	$1,298	$1,298	$1,000	$1,000	$2,298
Subtotal				$9,024		$95,369	$104,393
Nevada Sales Tax	3.75%	%		-		$3,576	$3,576
Subtotal							$107,969
Contractor OH & Profit	25.0%	%					$26,992
Subtotal							$134,961
Bond	1.5%	%					$2,024
Subtotal							$136,986
Estimating Contingency	10.0%	%					$13,699
Total Probable Construction Cost							**$150,684**

Lighting Retrofits - Detailed Calculations

Two types of energy saving retrofits are recommended for study buildings:

- Lighting fixture delamping, lamp and ballast modifications
- Lighting fixture lamp, ballast and reflector modifications

Specific measures recommended for each type of retrofit include:

Lighting Fixture and Control Retrofits Evaluated

Lighting ECO Number	Description
LD-1	Delamp and Retrofit from 2-Lamp F40T12 Fixture to a 1-Lamp F32T8 Fixture with Electronic Ballast
LD-2	Delamp and Retrofit from 4-Lamp F40T12 Fixture to a 2-Lamp F32T8 Fixture with Electronic Ballast
LF-1	Retrofit LED Lamp Kit in Existing Exit Lights
LF-4B	Delamp to 2xF32T8 Lamps & Install Reflector & Electronic Ballast in 4-Lamp F40T12 Fixtures
LF-5	Replace 100W Incandescent Lamp and Base with DTT-26W, 2700K, CRI 82 Compact Fluorescent & Ballast
LF-6	Replace 150W Incandescent Lamp and Base with DTT-26W, 2700K, CRI 80 Compact Fluorescent & Ballast
LF-7	Retrofit Existing 175W MV Exterior Light Fixtures with 50W HPS Lamps & Ballasts
LF-8	Retrofit Existing 400W Metal Halide Explosion Proof Fixtures with 250W HPS Lamps & Ballasts

Results of economic evaluations are summarized on Table 8. Calculations for each project appear on Tables 9 through 16. Detailed cost estimates, Life Cycle Cost Analysis summary sheets and catalog data for selected components are appended.

Fixture Delamping and Modification Evaluations

Delamping is considered for rooms audited with excessive levels of illumination according to Illumination Engineering Society guidance.

Delamping of two- and four-lamp F40T12 fixtures is considered, including retrofitting with F32T8 lamps and electronic ballasts. Half of the lamps are removed in each of the two delamping projects.

Detailed calculations appear on Tables 9 and 10.

Fixture Retrofit Evaluations

Lighting fixture modifications are considered. Existing fluorescent fixtures use 40-watt T12 fluorescent lamps and standard ballasts. Room-by-room calculations of fixture modifications evaluated for study buildings appear as Tables 11 through 16.

Retrofit LF-1 proposes to replace existing 6-watt fluorescent lamps in exit signs with light emitting diode (LED) lamp kits.

Retrofits LF-2, LF-3A, LF-3B, and LF-4A are one-for-one fluorescent lamp and ballast replacements in existing fixtures. None of these proposed retrofits proved economically justified or were not as attractive as recommended retrofits evaluated; no further coverage of these evaluations is provided.

Retrofit LF-4B involves installing a reflector and delamping existing 4-lamp fluorescent fixtures to two F32T8 lamps with electronic ballast. Retrofits LF-4A and LF-4B are evaluated for the same fixtures. Retrofit LF-4B has the best economics and is recommended.

Retrofits LF-5 and LF-6 are evaluated for replacing existing incandescent lamps in various fixtures with compact fluorescent lamps and ballasts. These retrofits involve modifying the fixtures such that only compact fluorescent lamps may be used.

Retrofit LF-7 involves the replacement of existing mercury vapor lamps with high pressure sodium lamps and ballasts.

Retrofit LF-8 replaces metal halide lamps with high pressure sodium lamps and ballasts.

Pricing shown on the attached unit cost estimates are taken, in large part, from the February 1994 issue of "Defense General Supply Center - Energy Efficient Lighting Catalog". Components are available at prices listed in this document to DoD agencies; it is assumed that contractor pricing would be similar. Catalog numbers are indicated on unit cost estimates.

Energy use for the existing fixtures is calculated in as described below. Energy savings and economic analysis calculations for fixture retrofits use the same calculation methodology:

Label	Contents / Calculation Explanation
TASK_CODE	Room function: See Table 20. (Field Data)
TYPE_CODE	Fixture Type: See Table 20. (Field Data)
LAMP_TYPE	Incandescent, Fluorescent, MV Mercury Vapor (Catalog Data) Refer to Table 17 for existing lamp/fixture types.
LAMPS/FXTR	Lamps per fixture (Field Data)
WATTS/FXTR	Watts per fixture (Refer to Table 17) (Catalog Data)
NO_FXTR	Number of fixtures in room/area (Field Data)
KW	WATTS/FXTR*NO_FXTR/1000=Connected Lighting load (kW)
HR/WK	Operating hours per week (Refer to Table 19) (Field Data)
DEMAND	Demand factor (Refer to Table 19)
KWH/Y	KW*HR/WK*52*DEMAND= Annual Power Use (kWH/year)

Lighting Retrofit Evaluation Calculations

Label	Contents / Calculation Explanation
KW_SVD	Difference in "Watts per Fixture" (E_KW) — (S_KW) = Demand savings (kW) from lighting retrofit values in Tables 17 and 18 (See note below)
KWH_SV	KW_SVD * HR/WK * 52 * Demand Factor = Usage Schedule (HR/WK) = Electric savings from retrofit and Demand Schedule are provided in Table 19.
DEM_$/Y	KW_SVD * $8.517 per kW-Mo * 12 Months per Year = Annual Electric Demand Cost Saving (Sierra Pacific demand charge, including Taxes)
USE_$/Y	KWH_SVD * $0.0438 = Annual electric power cost savings (Sierra Pacific power use charge, including Taxes)
PWR_LCC$	[DEM_$/Y + USE_$/Y] * 12.02 = Life cycle savings, Life of 15 years; UPV
O&M_$/Y	[Table 17 $/1000 LAMP-Hr - Table 18 $/1000 LAMP-Hr] * HR/WK * 52 * * No. FXTRS * NO. LAMPS / 1000 = Annual O&M savings (additional cost) for lamp replacements; refer to Tables 17 and 18
O&M_LCC $	(O&M_$/Y * 11.94) = Life cycle O&M cost for Life of 15 years; UPV
TOT_$/Y	(DEM_$/Y + USE_$/Y + O&M_$/Y) = Total annual cost savings
TOT_LCC$	(O&M_LCC$ + PWR_LCC$) = Total life cycle cost savings
CONST$	Retrofit Unit Cost * NO. FIXTURES = Construction cost from retrofit unit cost estimates, attached
SIOH	CONST$ * 0.120 = SIOH and design at 6% each of construction cost
INVE$T	CONST$ + SI0H = Total investment per ECIP guidance
SIR	(TOT_LCC$) / (INVE$T) = Savings-to-investment ratio
PAYBCK	(INVE$T) / (TOT_$/Y) = Payback period (years)

Notes: Parameters shown above for existing and retrofit (savings) cases are indicated by prefixes: "E_" and "S_", respectively, corresponding to labels used above to explain lighting energy use calculations. Refer to Tables 17 and 18 for existing and proposed retrofit energy use and O&M costs.

Sierra Pacific Power Company presently has no rebate programs in effect.

Table 8. Summary of Recommended Lighting System Modifications

Lighting ECO Number	Description	Number Retrofit Units	Demand Saved (kW)	Energy Saved (kWH/Year)	Electric Demand ($/Year)	Electric Usage ($/Year)	O&M Saved ($/Year)	Total LCC Cost Saved ($)	ECO Investment ($)	SIR	Payback (Years)
LD-1	Delamp and Retrofit from 2-Lamp F40T12 Fixture to a 1-Lamp F32T8 Fixture with Electronic Ballast	4	0.22	879	$22.49	$38.44	$6.89	$815	$302	2.69	4.46
LD-2	Delamp and Retrofit from 4-Lamp F40T12 Fixture to a 2-Lamp F32T8 Fixture with Electronic Ballast	57	6.33	22,109	$647	$967	$196	$21,745	$5,268	4.13	2.91
LF-1	Retrofit LED Lamp Kit in Existing Exit Lights	81	1.47	12,879	$151	$563	($56.60)	$7,908	$6,037	1.31	9.18
LF-4B	Delamp to 2xF32T8 Lamps & Install Reflector & Electronic Ballast in 4-Lamp F40T12 Fixtures	118	13.10	54,275	$1,339	$2,375	$371	$49,069	$9,925	4.94	2.43
LF-5	Replace 100W Incandescent lamp and base with DTT-26W, 2700K, CRI 82 Compact Fluorescent & Ballast	6	0.39	1,366	$40	$60	$63	$1,953	$309	6.33	1.90
LF-6	Replace 150W Incandescent lamp and base with DTT-26W, 2700K, CRI 80 Compact Fluorescent & Ballast	3	0.35	215	$35	$9	$6	$604	$154	3.91	3.07
LF-7	Retrofit Existing 175W MV Exterior Light Fixtures with 50W HPS Lamps & Ballasts	138	16.28	71,129	$1,664	$3,112	($261)	$54,297	$24,991	2.17	5.53
LF-8	Retrofit Existing 400W Metal Halide Explosion Proof Fixtures with 250W HPS Lamps & Ballasts	48	7.68	38,818	$785	$1,698	$175	$31,934	$10,980	2.91	4.13
Total Successful Lighting Fixture and Controls Retrofits		455	45.82	201,669	$4,683	$8,824	$501	$168,325	$57,967	2.90	4.14

Table 9. Delamping and Lighting Retrofit LD-1: 2-Lamp F40T12 to 1-Lamp F32T8 Fixtures

Building Number	Building Name	Room No / Name	Task Code	Type Code	Lamp Type	Watts/ Lamp	Lamp/ Fixture	Watts/ Fixture	No of Fixtures	Demand Factor	Fixture (Hr/Wk)	Watts/ECO Fixture	Demand Saved (kW)	Use Saved (kWH/Yr)	Energy ($/Yr)	O&M Saved ($/Yr)	Total Saved ($/Yr)	Total LCC$ Saved	Invest-ment ($)	SIR	Payback (Years)
117-1	Services & Support	21	1	R	F40T12	40	2	86	3	0.8	96	31	0.17	659	$45.69	$5.17	$50.86	$611	$227	2.69	4.46
117-1	Services & Support	24	1	R	F40T12	40	2	86	1	0.8	96	31	0.06	220	$15.23	$1.72	$16.95	$204	$76	2.69	4.46
Totals for ECO LD-1									4				0.22	878.59	$60.93	$6.89	$67.82	$814.59	$302.45	2.69	4.46

Table 10. Delamping and Lighting Retrofit LD-2: 4-Lamp F40T12 to 2-Lamp F32T8 Fixtures

Building Number	Building Name	Room No / Name	Task Code	Type Code	Lamp Type	Watts/ Lamp	Lamp/ Fixture	Watts/ Fixture	No of Fixtures	Demand Factor	Fixture (Hr/Wk)	Watts/ECO Fixture	Demand Saved (kW)	Use Saved (kWH/Yr)	Energy ($/Yr)	O&M Saved ($/Yr)	Total Saved ($/Yr)	Total LCC$ Saved	Invest-ment ($)	SIR	Payback (Years)
117-1	Services & Support	1	4	R	F40T12	40	4	172	4	0.7	96	61	0.44	1,552	$113.26	$13.78	$127.04	$1,526	$370	4.13	2.91
117-1	Services & Support	21	1	R	F40T12	40	4	172	2	0.8	96	61	0.22	887	$61.48	$6.89	$68.37	$821	$185	4.44	2.70
117-1	Services & Support	22	4	R	F40T12	40	4	172	2	0.7	96	61	0.22	776	$56.63	$6.89	$63.52	$763	$185	4.13	2.91
117-1	Services & Support	23	1	R	F40T12	40	4	172	5	0.8	96	61	0.56	2,216	$153.70	$17.22	$170.92	$2,053	$462	4.44	2.70
117-3	Decontam & Small Parts	Women's Lounge	8	S	F40T12	40	4	172	1	0.6	96	61	0.11	332	$25.89	$3.44	$29.34	$352	$92	3.81	3.15
117-3	Decontam & Small Parts	Control Room	4	R	F40T12	40	4	172	17	0.7	96	61	1.89	6,594	$481.37	$58.56	$539.92	$6,485	$1,571	4.13	2.91
117-4	Bulk Explosives Disposal	Women's Lounge	8	S	F40T12	40	4	172	1	0.6	96	61	0.11	332	$25.89	$3.44	$29.34	$352	$92	3.81	3.15
117-6	Steamout Building	Toilet - Mens'	8	S	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.89	$58.67	$705	$185	3.81	3.15
117-6	Steamout Building	Toilet - Womens'	8	S	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.89	$58.67	$705	$185	3.81	3.15
117-6	Steamout Building	Womens' Lounge	8	S	F40T12	40	4	172	1	0.6	96	61	0.11	332	$25.89	$3.44	$29.34	$352	$92	3.81	3.15
117-8	Mech. Removal Building	Men's W/C	8	S	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.89	$58.67	$705	$185	3.81	3.15
117-8	Mech. Removal Building	Women's W/C	8	S	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.89	$58.67	$705	$185	3.81	3.15
117-8	Mech. Removal Building	Women's Lounge	8	S	F40T12	40	4	172	1	0.6	96	61	0.11	332	$25.89	$3.44	$29.34	$352	$92	3.81	3.15
117-8	Mech. Removal Building	10, Control Room	4	R	F40T12	40	4	172	10	0.8	96	61	1.11	4,433	$307.40	$34.44	$341.85	$4,106	$924	4.44	2.70
117-10	Preparation Building	Women's W/C	8	R	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.89	$58.67	$705	$185	3.81	3.15
117-10	Preparation Building	Women's Lounge	8	R	F40T12	40	4	172	1	0.6	96	61	0.11	332	$25.89	$3.44	$29.34	$352	$92	3.81	3.15
117-10	Preparation Building	Men's W/C	8	R	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.89	$58.67	$705	$185	3.81	3.15
Totals for ECO LD-2									57				6.33	22109.07	$1,614	$196.34	$1,810	$21,745	$5,268	4.13	2.91

Energy Conservation Opportunity Legend

LD-1	Delamp and Retrofit from 2-Lamp F40T12 Fixture to a	1-Lamp F32T8 Fixture with Electronic Ballast
LD-2	Delamp and Retrofit from 4-Lamp F40T12 Fixture to a	2-Lamp F32T8 Fixture with Electronic Ballast

Table 11. Lighting Retrofit LF-1: Retrofit Light Emitting Diode (LED) Lamps in Exit Lights

Building Number	Building Name	Room No / Name	Task Code	Type Code	Lamp Type	Watts/ Lamp	Lamp/ Fixture	Watts/ Fixture	No of Fixtures	Demand Factor	Fixture (Hr/Wk)	Watts/ECO Fixture	Demand Saved (kW)	Use Saved (kWH/Yr)	Energy ($/Yr)	O&M Saved ($/Yr)	Total Saved ($/Yr)	Total LCC$ Saved	Invest-ment ($)	SIR	Payback (Years)
117-1	Services & Support	Exit Signs	Exit	S	F	6	2	20	9	1.0	168	1.8	0.16	1,431	$79.35	($6.29)	$73.06	$879	$671	1.31	9.18
117-3	Decontam & Small Parts	Exit Signs	Exit	S	F	6	2	20	12	1.0	168	1.8	0.22	1,908	$105.80	($8.39)	$97.41	$1,172	$894	1.31	9.18
117-4	Bulk Explosives Disposal	AG Exit	Exit	S	F	6	2	20	2	1.0	168	1.8	0.04	318	$17.63	($1.40)	$16.24	$195	$149	1.31	9.18
117-4	Bulk Explosives Disposal	UG Exit Signs	Exit	S	F	6	2	20	7	1.0	168	1.8	0.13	1,113	$61.72	($4.89)	$56.83	$683	$522	1.31	9.18
117-5	Refining Building	Exit Signs	Exit	S	F	6	2	20	11	1.0	168	1.8	0.20	1,749	$96.98	($7.69)	$89.30	$1,074	$820	1.31	9.18
117-6	Steamout Building	Exit Signs	Exit	S	F	6	2	20	18	1.0	168	1.8	0.33	2,862	$158.70	($12.58)	$146.12	$1,757	$1,342	1.31	9.18
117-8	Mech. Removal Building	Exit Signs	Exit	S	F	6	2	20	6	1.0	168	1.8	0.11	954	$52.90	($4.19)	$48.71	$586	$447	1.31	9.18
117-10	Preparation Building	Exit Signs	Exit	S	F	6	2	20	16	1.0	168	1.8	0.29	2,544	$141.07	($11.18)	$129.89	$1,562	$1,192	1.31	9.18
Totals for ECO LF-1									81				1.47	12,879	$714.15	($56.60)	$657.55	$7,908	$6,037	1.31	9.18

Table 12. Lighting Retrofit LF-4B: Retrofit 4-Lamp F40T12 Fixtures with Reflector and Delamp to 2 x F32T8 Lamps and Electronic Ballast

Building Number	Building Name	Room No / Name	Task Code	Type Code	Lamp Type	Watts/ Lamp	Lamp/ Fixture	Watts/ Fixture	No of Fixtures	Demand Factor	Fixture (Hr/Wk)	Watts/ECO Fixture	Demand Saved (kW)	Use Saved (kWH/Yr)	Energy ($/Yr)	O&M Saved ($/Yr)	Total Saved ($/Yr)	Total LCC$ Saved	Invest-ment ($)	SIR	Payback (Years)
117-1	Services & Support	5	18	R	F40T12	40	4	172	16	1.0	96	61	1.78	8,866	$569.42	$48.80	$618.23	$7,427	$1,346	5.52	2.18
117-1	Services & Support	18	4	R	F40T12	40	4	172	2	0.7	96	61	0.22	776	$56.63	$6.10	$62.73	$754	$168	4.48	2.68
117-1	Services & Support	19	4	R	F40T12	40	4	172	2	0.7	96	61	0.22	776	$56.63	$6.10	$62.73	$754	$168	4.48	2.68
117-1	Services & Support	20	4	R	F40T12	40	4	172	15	0.7	96	61	1.67	5,818	$424.74	$45.75	$470.49	$5,652	$1,262	4.48	2.68
117-3	Decontam & Small Parts	Supervisor Office	4	R	F40T12	40	4	172	9	0.7	96	61	1.00	3,491	$254.84	$27.45	$282.29	$3,391	$757	4.48	2.68
117-3	Decontam & Small Parts	Corridor	1	S	F40T12	40	4	172	2	1.0	96	61	0.22	1,108	$71.18	$6.10	$77.28	$928	$168	5.52	2.18
117-3	Decontam & Small Parts	Men's W/C	8	S	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.10	$57.88	$695	$168	4.13	2.91
117-3	Decontam & Small Parts	Women's W/C	8	S	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.10	$57.88	$695	$168	4.13	2.91
117-4	Bulk Explosives Disposal	UG Control Room	4	R	F40T12	40	4	172	17	0.9	96	61	1.89	8,478	$563.80	$51.86	$615.65	$7,396	$1,430	5.17	2.32
117-4	Bulk Explosives Disposal	UG Toilet - Women	8	S	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.10	$57.88	$695	$168	4.13	2.91
117-4	Bulk Explosives Disposal	UG Corridor	1	S	F40T12	40	4	172	2	0.8	96	61	0.22	887	$61.48	$6.10	$67.58	$812	$168	4.83	2.49
117-4	Bulk Explosives Disposal	UG Toilet - Men	8	S	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.10	$57.88	$695	$168	4.13	2.91
117-6	Steamout Building	Corridor	1	S	F40T12	40	4	172	4	0.6	96	61	0.44	1,330	$103.57	$12.20	$115.77	$1,391	$336	4.13	2.91
117-6	Steamout Building	Lab	18	R	F40T12	40	4	172	7	0.7	96	61	0.78	2,715	$198.21	$21.35	$219.56	$2,637	$589	4.48	2.68
117-7	Water Treatment	Control Rm	4	S	F40T12	40	4	172	5	1.0	168	61	0.56	4,848	$268.86	$26.69	$295.55	$3,550	$421	8.44	1.42
117-8	Mech. Removal Building	Supervisor's Office	4	R	F40T12	40	4	172	2	0.8	96	61	0.22	887	$61.48	$6.10	$67.58	$812	$168	4.83	2.49
117-8	Mech. Removal Building	Corridor	1	S	F40T12	40	4	172	2	0.6	96	61	0.22	665	$51.78	$6.10	$57.88	$695	$168	4.13	2.91
117-10	Preparation Building	Corridor	1	R	F40T12	40	4	172	2	0.7	96	61	0.22	776	$56.63	$6.10	$62.73	$754	$168	4.48	2.68
117-10	Preparation Building	Control Rm	4	R	F40T12	40	4	172	15	0.8	96	61	1.67	6,649	$461.10	$45.75	$506.86	$6,089	$1,262	4.83	2.49
117-10	Preparation Building	Supervisor's Office	4	R	F40T12	40	4	172	8	0.8	96	61	0.89	3,546	$245.92	$24.40	$270.32	$3,247	$673	4.83	2.49
Totals for ECO LF-4B									118				13.10	54,275	$3,713	$371.38	$4,084.78	$49,069	$9,925	4.94	2.43

Table 13. Lighting Retrofit LF-5: Modify 100 Watt Incandescent Fixtures for DTT-26 Watt Compact Fluorescent Lamps

Building Number	Building Name	Room No / Name	Task Code	Type Code	Lamp Type	Watts/ Lamp	Lamp/ Fixture	Watts/ Fixture	No of Fixtures	Demand Factor	Fixture (Hr/Wk)	Watts/ECO Fixture	Demand Saved (kW)	Use Saved (kWH/Yr)	Energy ($/Yr)	O&M Saved ($/Yr)	Total Saved ($/Yr)	Total LCC$ Saved	Invest-ment ($)	SIR	Payback (Years)
117-3	Decontam & Small Parts	Janitor's Closet	16	S	I	100	1	100	1	1.0	8	35	0.07	27	$7.83	$1.25	$9.08	$109	$51	2.12	5.67
117-4	Bulk Explosives Disposal	AG Roof	14	P-ExP	I	100	1	100	4	1.0	96	35	0.26	1,298	$83.36	$60.16	$143.53	$1,720	$206	8.36	1.43
117-4	Bulk Explosives Disposal	UG Janitor Closet	16	S	I	100	1	100	1	1.0	8	35	0.07	27	$7.83	$1.25	$9.08	$109	$51	2.12	5.67
117-5	Refining Building	Janitor's Closet	16	S	I	100	1	100	1	1.0	12	35	0.07	41	$8.42	$1.88	$10.30	$124	$51	2.40	5.00
Totals for ECO LF-5									6				0.39	1,366	$99.61	$63.30	$162.90	$1,953	$309	6.33	1.90

Table 14. Lighting Retrofit LF-6: Modify 150 Watt Incandescent Fixtures for DTT-26 Watt Compact Fluorescent Lamps

Building Number	Building Name	Room No / Name	Task Code	Type Code	Lamp Type	Watts/ Lamp	Lamp/ Fixture	Watts/ Fixture	No of Fixtures	Demand Factor	Fixture (Hr/Wk)	Watts/ECO Fixture	Demand Saved (kW)	Use Saved (kWH/Yr)	Energy ($/Yr)	O&M Saved ($/Yr)	Total Saved ($/Yr)	Total LCC$ Saved	Invest-ment ($)	SIR	Payback (Years)
117-6	Steamout Building	Janitor's Closet	16	S	I	150	1	150	1	1.0	12	35	0.12	72	$14.89	$1.88	$16.77	$201	$51	3.91	3.07
117-8	Mech. Removal Building	Jan Closet	16	S	I	150	1	150	1	1.0	12	35	0.12	72	$14.89	$1.88	$16.77	$201	$51	3.91	3.07
117-10	Preparation Building	Janitor's Closet	16	S	I	150	1	150	1	1.0	12	35	0.12	72	$14.89	$1.88	$16.77	$201	$51	3.91	3.07
Totals for ECO LF-6									3				0.35	215	$44.68	$5.64	$50.32	$604	$154	3.91	3.07

Table 15. Lighting Retrofit LF-7: Retrofit Existing 175 Watt Mercury Vapor Fixtures with 50 Watt High Pressure Sodium Lamps and Ballasts

Building Number	Building Name	Room No / Name	Task Code	Type Code	Lamp Type	Watts/ Lamp	Lamp/ Fixture	Watts/ Fixture	No of Fixtures	Demand Factor	Fixture (Hr/Wk)	Watts/ECO Fixture	Demand Saved (kW)	Use Saved (kWH/Yr)	Energy ($/Yr)	O&M Saved ($/Yr)	Total Saved ($/Yr)	Total LCC$ Saved	Invest-ment ($)	SIR	Payback (Years)
117-1	Services & Support	Exterior	Extr	S	MV	175	1	198	4	1.0	84	80	0.47	2,062	$138.45	($7.56)	$130.88	$1,574	$724	2.17	5.53
117-2	Boiler Building	Exterior	Extr	S	MV	175	1	198	20	1.0	84	80	2.36	10,308	$692.23	($37.82)	$654.41	$7,869	$3,622	2.17	5.53
117-3	Decontam & Small Parts	Exterior	Extr	S	MV	175	1	198	43	1.0	84	80	5.07	22,163	$1,488	($81.31)	$1,406.99	$16,919	$7,787	2.17	5.53
117-4	Bulk Explosives Disposal	Exterior	Extr	S	MV	175	1	198	3	1.0	84	80	0.35	1,546	$103.84	($5.67)	$98.16	$1,180	$543	2.17	5.53
117-4	Bulk Explosives Disposal	Exterior	Extr	S	MV	175	1	198	2	1.0	84	80	0.24	1,031	$69.22	($3.78)	$65.44	$787	$362	2.17	5.53
117-5	Refining Building	Exterior	Extr	S	MV	175	1	198	16	1.0	84	80	1.89	8,247	$553.79	($30.26)	$523.53	$6,295	$2,898	2.17	5.53
117-6	Steamout Building	Exterior	Extr	S	MV	175	1	198	15	1.0	84	80	1.77	7,731	$519.18	($28.36)	$490.81	$5,902	$2,716	2.17	5.53
117-6A	Pump Building	Exterior	Extr	S	MV	175	1	198	3	1.0	84	80	0.35	1,546	$103.84	($5.67)	$98.16	$1,180	$543	2.17	5.53
117-7	Water Treatment	Exterior	Extr	S	MV	175	1	198	5	1.0	84	80	0.59	2,577	$173.06	($9.45)	$163.60	$1,967	$905	2.17	5.53
117-8	Mech. Removal Building	Exterior	Extr	S	MV	175	1	198	9	1.0	84	80	1.06	4,639	$311.51	($17.02)	$294.49	$3,541	$1,630	2.17	5.53
117-10	Preparation Building	Exterior	Extr	S	MV	175	1	198	15	1.0	84	80	1.77	7,731	$519.18	($28.36)	$490.81	$5,902	$2,716	2.17	5.53
117-11	Accumulator Building	Exterior	Extr	S	MV	175	1	198	3	1.0	84	80	0.35	1,546	$103.84	($5.67)	$98.16	$1,180	$543	2.17	5.53
Totals for ECO LF-7									138				16.28	71,129	$4,776	($260.96)	$4,515.46	$54,297	$24,991	2.17	5.53

Table 16. Lighting Retrofit LF-8: Retrofit Existing 400 Watt Metal Halide Fixtures with 250 Watt High Pressure Sodium Lamps and Ballasts

Building Number	Building Name	Room No / Name	Task Code	Type Code	Lamp Type	Watts/ Lamp	Lamp/ Fixture	Watts/ Fixture	No of Fixtures	Demand Factor	Fixture (Hr/Wk)	Watts/ECO Fixture	Demand Saved (kW)	Use Saved (kWH/Yr)	Energy ($/Yr)	O&M Saved ($/Yr)	Total Saved ($/Yr)	Total LCC$ Saved	Invest-ment ($)	SIR	Payback (Years)
117-4	Bulk Explosives Disposal	AG Cell 1	14	P-ExP	MH	400	1	460	8	1.0	96	300	1.28	6,390	$410.40	$24.49	$434.89	$5,225	$1,830	2.86	4.21
117-4	Bulk Explosives Disposal	AG Cell 2	14	P-ExP	MH	400	1	460	8	1.0	96	300	1.28	6,390	$410.40	$24.49	$434.89	$5,225	$1,830	2.86	4.21
117-5	Refining Building	Top Level Processing	14	P-ExP	MH	400	1	460	8	1.0	96	300	1.28	6,390	$410.40	$24.49	$434.89	$5,225	$1,830	2.86	4.21
117-6	Steamout Building	South Tower	14	P-ExP	MH	400	1	460	12	1.0	96	300	1.92	9,585	$615.59	$36.74	$652.33	$7,838	$2,745	2.86	4.21
117-7	Water Treatment	Filter Room	14	P-ExP	MH	400	1	460	9	0.6	168	300	1.44	7,548	$477.42	$48.22	$525.64	$6,314	$2,059	3.07	3.92
117-7	Water Treatment	Chem Tanks	14	P-ExP	MH	400	1	460	3	0.6	168	300	0.48	2,516	$159.14	$16.07	$175.21	$2,105	$686	3.07	3.92
Totals for ECO LF-8									48				7.68	38,818	$2,483	$174.52	$2,657.86	$31,934	$10,980	2.91	4.13

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant, Western Area Demilitarization Facility — Region No. 4 — Project No.

Project Title: ECIP Facility Energy Improvements: Total Successful Lighting Fixture Retrofits — Fiscal Year FY96

Analysis Date: March 1995 — Economic Life: 15 Years — Preparer: KELLER & GANNON

1. Investment Costs		
A. Construction Costs	$51,756	
B. SIOH	$3,105	
C. Design Cost	$3,105	
D. Total Cost (1A + 1B + 1C)	$57,967	
E. Salvage Value of Existing Equipment		$0
F. Public Utility Company Rebate		$0
G. Total Investment (1D-1E-1F)		$57,967

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	688.30		$8,824	12.02	$106,060
B. Dist	$13.25	0		$0	14.23	$0
C. LPG						
D. Other						
E. Demand Saved	$102.21	45.82	kW	$4,683	12.02	$56,288
F. Total	($/kW-Year)	688.30		$13,507		$162,349

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$500.50	
(1) Discount Factor (Table A)		11.94
(2) Discounted Savings/Cost (3A x 3A1)		$5,976

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2 + 3Bd4)	$5,976	
4. First Year Dollar Savings (2F3 + 3A + (3Bd1/Economic Life)):	$14,007	
5. Simple Payback (1G/4):	4.14	Years
6. Total Net Discounted Savings (2F5 + 3C):	$168,325	
7. Savings to Investment Ratio (SIR) (6/1G):	2.90	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant, Western Area Demilitarization Facility — Region No. 4 — Project No.

Project Title: ECIP Facility Energy Improvements: **ECO LD-1:** Delamp and Retrofit from 2-Lamp F40T12 Fixture to a 1-Lamp F32T8 Fixture with Electronic Ballast — Fiscal Year FY96

Analysis Date: March 1995 — Economic Life: 15 Years — Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$270		
B. SIOH	$16		
C. Design Cost	$16		
D. Total Cost (1A+1B+1C)	$302		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$302

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	3.00		$38	12.02	$462
B. Dist	$13.25	0		$0	14.23	$0
C. LPG						
D. Other						
E. Demand Saved	$102.21	0.22	kW	$22	12.02	$270
F. Total	($/kW-Year)	3.00		$61		$732

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$6.89		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			$82

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	$82	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$68	
5. Simple Payback (1G/4):	4.46	Years
6. Total Net Discounted Savings (2F5+3C):	$815	
7. Savings to Investment Ratio (SIR) (6/1G):	2.69	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant, Western Area Demilitarization Facility — Region No. 4 — Project No.

Project Title: ECIP Facility Energy Improvements: **ECO LD-2:** Delamp and Retrofit from 4-Lamp F40T12 Fixture to a 2-Lamp F32T8 Fixture with Electronic Ballast — Fiscal Year FY96

Analysis Date: March 1995 — Economic Life: 15 Years — Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$4,704		
B. SIOH	$282		
C. Design Cost	$282		
D. Total Cost (1A+1B+1C)	$5,268		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$5,268

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	75.46		$967	12.02	$11,627
B. Dist	$13.25	0		$0	14.23	$0
C. LPG						
D. Other						
E. Demand Saved	$102.21	6.33	kW	$647	12.02	$7,773
F. Total	($/kW-Year)	75.46		$1,614		$19,400

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$196.34		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			$2,344

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	$2,344	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$1,810	
5. Simple Payback (1G/4):	2.91	Years
6. Total Net Discounted Savings (2F5+3C):	$21,745	
7. Savings to Investment Ratio (SIR) (6/1G):	4.13	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant, Western Area Demilitarization Facility — Region No. 4 — Project No.

Project Title: ECIP Facility Energy Improvements: **ECO LF-1:** Retrofit LED Lamp Kit in Existing Exit Lights — Fiscal Year FY96

Analysis Date: March 1995 — Economic Life: 15 Years — Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$5,390		
B. SIOH	$323		
C. Design Cost	$323		
D. Total Cost (1A+1B+1C)	$6,037		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$6,037

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	43.95		$563	12.02	$6,773
B. Dist	$13.25	0		$0	14.23	$0
C. LPG						
D. Other						
E. Demand Saved	$102.21	1.47	kW	$151	12.02	$1,811
F. Total	($/kW-Year)	43.95		$714		$8,584

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($56.60)		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			($676)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	($676)	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$658	
5. Simple Payback (1G/4):	9.18	Years
6. Total Net Discounted Savings (2F5+3C):	$7,908	
7. Savings to Investment Ratio (SIR) (6/1G):	1.31	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant, Western Area Demilitarization Facility — Region No. 4 — Project No.

Project Title: ECIP Facility Energy Improvements: **ECO LF-4B**: Delamp to 2xF32T8 Lamps & Install Reflector & Electronic Ballast in 4-Lamp F40T12 Fixtures — Fiscal Year FY96

Analysis Date: March 1995 — Economic Life: 15 Years — Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$8,862		
B. SIOH	$532		
C. Design Cost	$532		
D. Total Cost (1A+1B+1C)	$9,925		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$9,925

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	185.24		$2,375	12.02	$28,544
B. Dist	$13.25	0		$0	14.23	$0
C. LPG						
D. Other						
E. Demand Saved	$102.21	13.10	kW	$1,339	12.02	$16,091
F. Total	($/kW-Year)	185.24		$3,713		$44,635

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$371.38		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			$4,434

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	$4,434	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$4,085	
5. Simple Payback (1G/4):	2.43	Years
6. Total Net Discounted Savings (2F5+3C):	$49,069	
7. Savings to Investment Ratio (SIR) (6/1G):	4.94	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant, Western Area Demilitarization Facility — Region No. 4 — Project No.

Project Title: ECIP Facility Energy Improvements: **ECO LF-5:** Replace 100W Incandescent lamp and base with DTT-26W, 2700K, CRI 82 Compact Fluorescent & Ballast — Fiscal Year FY96

Analysis Date: March 1995 — Economic Life: 15 Years — Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$276		
B. SIOH	$17		
C. Design Cost	$17		
D. Total Cost (1A+1B+1C)	$309		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$309

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	4.66		$60	12.02	$718
B. Dist	$13.25	0		$0	14.23	$0
C. LPG						
D. Other						
E. Demand Saved	$102.21	0.39	kW	$40	12.02	$479
F. Total	($/kW-Year)	4.66		$100		$1,197

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$63.30		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			$756

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	$756	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$163	
5. Simple Payback (1G/4):	1.90	Years
6. Total Net Discounted Savings (2F5+3C):	$1,953	
7. Savings to Investment Ratio (SIR) (6/1G):	6.33	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant, Western Area Demilitarization Facility — Region No. 4 — Project No.

Project Title: ECIP Facility Energy Improvements: **ECO LF-6:** Replace 150W Incandescent lamp and base with DTT-26W, 2700K, CRI 80 Compact Fluorescent & Ballast — Fiscal Year FY96

Analysis Date: March 1995 — Economic Life: 15 Years — Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$138		
B. SIOH	$8		
C. Design Cost	$8		
D. Total Cost (1A+1B+1C)	$154		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$154

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	0.73		$9	12.02	$113
B. Dist	$13.25	0		$0	14.23	$0
C. LPG						
D. Other						
E. Demand Saved	$102.21	0.35	kW	$35	12.02	$424
F. Total	($/kW-Year)	0.73		$45		$537

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$5.64		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			$67

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	$67	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$50	
5. Simple Payback (1G/4):	3.07	Years
6. Total Net Discounted Savings (2F5+3C):	$604	
7. Savings to Investment Ratio (SIR) (6/1G):	3.91	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant, Western Area Demilitarization Facility — Region No. 4 — Project No.

Project Title: ECIP Facility Energy Improvements: **ECO LF-7:** Retrofit Existing 175W MV Exterior Light Fixtures with 50W HPS Lamps & Ballasts — Fiscal Year FY96

Analysis Date: March 1995 — Economic Life: 15 Years — Preparer: KELLER & GANNON

1. Investment Costs			
A. Construction Costs	$22,314		
B. SIOH	$1,339		
C. Design Cost	$1,339		
D. Total Cost (1A+1B+1C)	$24,991		
E. Salvage Value of Existing Equipment		$0	
F. Public Utility Company Rebate		$0	
G. Total Investment (1D-1E-1F)			$24,991

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	242.76		$3,112	12.02	$37,407
B. Dist	$13.25	0		$0	14.23	$0
C. LPG						
D. Other						
E. Demand Saved	$102.21	16.28	kW	$1,664	12.02	$20,005
F. Total	($/kW-Year)	242.76		$4,776		$57,413

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	($260.96)		
(1) Discount Factor (Table A)		11.94	
(2) Discounted Savings/Cost (3A x 3A1)			($3,116)

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	($3,116)	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$4,515	
5. Simple Payback (1G/4):	5.53	Years
6. Total Net Discounted Savings (2F5+3C):	$54,297	
7. Savings to Investment Ratio (SIR) (6/1G):	2.17	

Life Cycle Cost Analysis Summary
Energy Conservation Investment Program (ECIP)

Location: Hawthorne Army Ammunition Plant, Western Area Demilitarization Facility — Region No. 4 — Project No.

Project Title: ECIP Facility Energy Improvements: **ECO LF-8:** Retrofit Existing 400W Metal Halide Explosion Proof Fixtures with 250W HPS Lamps & Ballasts — Fiscal Year FY96

Analysis Date: March 1995 — Economic Life: 15 Years — Preparer: KELLER & GANNON

1. Investment Costs		
A. Construction Costs	$9,804	
B. SIOH	$588	
C. Design Cost	$588	
D. Total Cost (1A+1B+1C)	$10,980	
E. Salvage Value of Existing Equipment	$0	
F. Public Utility Company Rebate	$0	
G. Total Investment (1D-1E-1F)		$10,980

2. Energy Savings (+)/Cost(-):

Date of NISTIR 85-3273 Used for Discount Factors: October 1994

Energy Source	Cost $/MBTU	Saving MBTU/Yr(2)		Annual $ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec.	$12.82	132.49		$1,698	12.02	$20,415
B. Dist	$13.25	0		$0	14.23	$0
C. LPG						
D. Other						
E. Demand Saved	$102.21	7.68	kW	$785	12.02	$9,435
F. Total	($/kW-Year)	132.49		$2,483		$29,850

3. Non Energy Savings (+) or Cost (-):

A. Annual Recurring (+/-)	$174.52	
(1) Discount Factor (Table A)	11.94	
(2) Discounted Savings/Cost (3A x 3A1)		$2,084

B. Non Recurring Savings (+) or Cost (-)

Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(4)
a.				
b.				
c.				
d. Total				

C Total Non Energy Discounted Savings (3A2+3Bd4)	$2,084	
4. First Year Dollar Savings (2F3+3A+(3Bd1/Economic Life)):	$2,658	
5. Simple Payback (1G/4):	4.13	Years
6. Total Net Discounted Savings (2F5+3C):	$31,934	
7. Savings to Investment Ratio (SIR) (6/1G):	2.91	

CONSTRUCTION COST ESTIMATE

Date Prepared	Sheet	of
Mar-95	1	4

Project: ECIP Facility Energy Improvements

Project No.:

Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada

Basis for Estimate: **Code A (no design competed)**

Engineer-Architect: Keller & Gannon

Drawing No.: **Lighting ECO Unit Costs**

Estimator: **BIH**

Checked By: **RCL**

Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
LD-1. Delamp & Retrofit:	**From 2-Lamp F40T12 Fixture to a 1-Lamp F32T8 Fixture with Electronic Ballast**						
Remove 1 F40T12 Lamp & Pin Connectors	1	EA	$2.50	$2.50	$0.00	$0.00	$2.50
Electronic Ballast: 6250-01-353-7722	1	EA	$12.50	$12.50	$25.00	$25.00	$37.50
F32T8 Lamp: 6240-01-344-9943 or 9508	1	EA	$4.50	$4.50	$2.83	$2.83	$7.33
Subtotal				$19.50		$27.83	$47.33
Nevada Sales Tax	3.75%	%		-		$1.04	$1.04
Subtotal							$48.37
Contractor OH & Profit	25.0%	%					$12.09
Subtotal							$60.47
Bond	1.5%	%					$0.91
Subtotal							$61.37
Estimating Contingency	10.0%	%					$6.14
Total Probable Construction Cost							**$67.51**
LD-2. Delamp & Retrofit:	**From 4-Lamp F40T12 Fixture to a 2-Lamp F32T8 Fixture with Electronic Ballast**						
Remove 1 F40T12 Lamp & Pin Connectors	2	EA	$2.50	$5.00	$0.00	$0.00	$5.00
Electronic Ballast: 6250-01-379-3041	1	EA	$15.00	$15.00	$25.00	$25.00	$40.00
F32T8 Lamp: 6240-01-344-9943 or 9508	2	EA	$3.66	$7.32	$2.83	$5.66	$12.98
Subtotal				$27.32		$30.66	$57.98
Nevada Sales Tax	3.75%	%		-		$1.15	$1.15
Subtotal							$59.13
Contractor OH & Profit	25.0%	%					$14.78
Subtotal							$73.91
Bond	1.5%	%					$1.11
Subtotal							$75.02
Estimating Contingency	10.0%	%					$7.50
Total Probable Construction Cost							**$82.52**

Note: Labor costs are based on a subcontractor rate of $30/hour including burden for electricians.

CONSTRUCTION COST ESTIMATE					Date Prepared Mar-95		Sheet 2 of 4
Project: ECIP Facility Energy Improvements					Project No.	Basis for Estimate: Code A (no design competed)	
Location: Western Area Demilitarization Facility (WADF), Hawthorne Army Ammunition Plant, Nevada							
Engineer-Architect: Keller & Gannon							
Drawing No.: **Lighting ECO Unit Costs**			Estimator: **BIH**			Checked By: **RCL**	
Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
LF-1. Exit Light LED Retrofit							
LED Kit: 277V, 6240-01-381-2061	1	EA	$15.00	$15.00	$31.50	$31.50	$46.50
Nevada Sales Tax	3.75%	%		-		$1.18	$1.18
Subtotal							$47.68
Contractor OH & Profit	25.0%	%					$11.92
Subtotal							$59.60
Bond	1.5%	%					$0.89
Subtotal							$60.50
Estimating Contingency	10.0%	%					$6.05
Total Probable Construction Cost							**$66.55**
LF-4B. F40T12, 4 Lamp Fixtures:	**Retrofit Reflector, Delamp to 2 each F32T8 Lamps and an Electronic Ballast**						
Electronic Ballast: 277V=6250-01-379-3041	1	EA	$17.50	$17.50	$25.00	$25.00	$42.50
F32T8 Lamp: 6240-01-344-9943 or 9508	2	EA	$2.25	$4.50	$2.83	$5.66	$10.16
Reflector Retrofit for Delamping: R302-348T8 SSB 2'x4' for 3xF32T8	1	EA	$6.00	$6.00	$49.00	$49.00	$55.00
Subtotal				$22.00		$30.66	$52.66
Nevada Sales Tax	3.75%	%		-		$1.15	$1.15
Subtotal							$53.81
Contractor OH & Profit	25.0%	%					$13.45
Subtotal							$67.26
Bond	1.5%	%					$1.01
Subtotal							$68.27
Estimating Contingency	10.0%	%					$6.83
Total Probable Construction Cost							**$75.10**

Note: Labor costs are based on a subcontractor rate of $30/hour including burden for electricians.

CONSTRUCTION COST ESTIMATE			Date Prepared Mar-95		Sheet 3	of 4
Project ECIP Facility Energy Improvements			Project No.		Basis for Estimate	
Location Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada					Code A (no design competed)	
Engineer-Architect Keller & Gannon						
Drawing No. **Lighting ECO Unit Costs**			Estimator **BIH**		Checked By **RCL**	

Line Item	Quantity		Labor		Material		Total Cost
	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	
LF-5. 100W Incandescent Fixture: Replace Fixture with DTT 26W Compact Fluorescent Lamp, Base and Ballast							
Remove Existing Incandescent Fixture	1	EA	$7.50	$7.50	$0.00	$0.00	$7.50
Advance (or Equal) L-1Q26TP Ballast	1	EA	$6.00	$6.00	$0.89	$0.89	$6.89
Adaptor Base: 26 Watt, G240-3, 6250-01-352-1529	1	EA	$2.50	$2.50	$5.79	$5.79	$8.29
DTT 26W, 2700K CRI 82 Compact Fluorescent Lamp: 6240-01-345-9535	1	EA	$2.50	$2.50	$7.23	$7.23	$9.73
Subtotal				$18.50		$13.90	$32.40
Nevada Sales Tax	3.75%	%		-		$0.52	$0.52
Subtotal							$32.92
Contractor OH & Profit	25.0%	%					$8.23
Subtotal							$41.15
Bond	1.5%	%					$0.62
Subtotal							$41.77
Estimating Contingency	10.0%	%					$4.18
Total Probable Construction Cost							**$45.95**
LF-6. 150W Incandescent Fixture: Replace Fixture with DTT 26W Compact Fluorescent Lamp, Base and Ballast							
Remove Existing Incandescent Fixture	1	EA	$7.50	$7.50	$0.00	$0.00	$7.50
Advance (or Equal) L-1Q26TP Ballast	1	EA	$6.00	$6.00	$0.89	$0.89	$6.89
Adaptor Base: 26 Watt, G240-3, 6250-01-352-1529	1	EA	$2.50	$2.50	$5.79	$5.79	$8.29
DTT 26W, 2700K CRI 82 Compact Fluorescent Lamp: 6240-01-345-9535	1	EA	$2.50	$2.50	$7.23	$7.23	$9.73
Subtotal				$18.50		$13.90	$32.40
Nevada Sales Tax	3.75%	%		-		$0.52	$0.52
Subtotal							$32.92
Contractor OH & Profit	25.0%	%					$8.23
Subtotal							$41.15
Bond	1.5%	%					$0.62
Subtotal							$41.77
Estimating Contingency	10.0%	%					$4.18
Total Probable Construction Cost							**$45.95**

Note: Labor costs are based on a subcontractor rate of $30/hour including burden for electricians.

CONSTRUCTION COST ESTIMATE					Date Prepared Mar-95		Sheet 4 of 4
Project: ECIP Facility Energy Improvements				Project No.	Basis for Estimate: Code A (no design competed)		
Location: Western Area Demilitarization Facility (WADF) Hawthorne Army Ammunition Plant, Nevada							
Engineer-Architect: Keller & Gannon							
Drawing No.: **Lighting ECO Unit Costs**			Estimator: **BIH**		Checked By: **RCL**		
Line Item	Quantity No. Units	Quantity Unit Meas.	Labor Per Unit	Labor Total	Material Per Unit	Material Total	Total Cost
LF-7. 175W MV Fixture:	**Retrofit with 50 Watt High Pressure Sodium (HPS) Lamp and Ballast**						
Ballast, 50W S-68: 6250-01-348-6628	1	EA	$27.00	$27.00	$53.02	$53.02	$80.02
HPS Lamp 50W ANSI S-68 E-23 1/2 Coated: 6240-01-228-9595	1	EA	$9.00	$9.00	$23.95	$23.95	$32.95
Subtotal				$36.00		$76.97	$112.97
Nevada Sales Tax	3.75%	%		-		$2.89	$2.89
Subtotal							$115.86
Contractor OH & Profit	25.0%	%					$28.96
Subtotal							$144.82
Bond	1.5%	%					$2.17
Subtotal							$146.99
Estimating Contingency	10.0%	%					$14.70
Total Probable Construction Cost							**$161.69**
LF-8. 400W MV Fixture: (Explosion Proof Fixtures)	**Retrofit with 250 Watt High Pressure Sodium (HPS) Lamp and Ballast**						
Ballast, 250W S-50: 6250-01-348-6629	1	EA	$27.60	$27.60	$78.38	$78.38	$105.98
HPS Lamp 250W ANSI S-50 E-28 Coated: 6240-01-094-8332	1	EA	$9.00	$9.00	$27.40	$27.40	$36.40
Subtotal				$36.60		$105.78	$142.38
Nevada Sales Tax	3.75%	%		-		$3.97	$3.97
Subtotal							$146.35
Contractor OH & Profit	25.0%	%					$36.59
Subtotal							$182.93
Bond	1.5%	%					$2.74
Subtotal							$185.68
Estimating Contingency	10.0%	%					$18.57
Total Probable Construction Cost							**$204.25**

Note: Labor costs are based on a subcontractor rate of $30/hour including burden for electricians.

Table 17. Energy Use and Operating Costs of Existing Lighting Fixtures

Existing Fixture Type Description	Watts per Fixture	Lamp Life (Hours)	Lamp Cost ($ Each)	Labor (Hr/Lamp)	Cost/1,000 Lamp-Hrs	Proposed Lighting Fixture Retrofits
Lighting Fixture Delamping with Lamp and Ballast Retrofits						
F40T12 - 2 Lamps per Fixture - Standard Fixture	86.0	20,000	$2.75	0.150	$0.363	LD-1: Delamp and Retrofit from 2-Lamp F40T12 Fixture to a 1-Lamp F32T8 Fixture with Electronic Ballast
F40T12 - 4 Lamps per Fixture - Standard Fixture	172.0	20,000	$2.75	0.122	$0.321	LD-2: Delamp and Retrofit from 4-Lamp F40T12 Fixture to a 2-Lamp F32T8 Fixture with Electronic Ballast
Lighting Fixture Lamp and/or Ballast Retrofits						
Exit Light: F-6W - 2 Lamps per Fixture	20.0	131,400	$2.45	0.083	$0.038	LF-1: Retrofit LED Lamp Kit in Existing Exit Lights
F40T12 - 4 Lamps per Fixture - Standard Fixture	172.0	20,000	$2.75	0.122	$0.321	LF-4B: Delamping & Reflector + Electronic Ballast and 2xF32T8 Lamps
F48T12VH - 2 Lamps per Fixture - Explosion Proof Fixture	250.0	12,000	$16.31	0.375	$2.297	None: Required illumination cannot be achieved with the same number of any other type lamp using less energy, even with an addition of a specular reflector.
I-100W - 1 Lamp per Fixture - Ceiling & Wall Mounted	100.0	750	$0.51	0.083	$4.000	LF-5: Replace lamp and base with DTT-26W, 2700K, CRI 80 Compact Fluorescent
I-150W - 1 Lamp per Fixture - Ceiling & Wall Mounted	150.0	750	$0.51	0.083	$4.000	LF-6: Replace lamp and base with DTT-26W, 2700K, CRI 80 Compact Fluorescent
MV 175W - Pendant-Mount	198.0	24,000	$14.10	0.300	$0.963	LF-7: Retrofit with 50W HPS Lamp & Ballast
MH 400W - Pendant-Mount	460.0	20,000	$34.05	0.300	$2.153	LF-8: Retrofit with 250W HPS Lamp & Ballast

"Standard Fixtures" are either recessed or surface mounted, including lens.

Lamp replacement labor costs are based on a rate of $20 per hour plus 50% for burden and overhead. The labor rate is, thus, $30 per hour.

Table 18. Energy Use and Operating Costs of Proposed Lighting Fixture Retrofits

Proposed Lighting Fixture (LF) Retrofits	Watts per Fixture	Lamp Life (Hours)	Lamp Cost ($ Each)	Labor (Hr/Lamp)	Cost/1,000 Lamp-Hrs
Lighting Fixture Delamping with Lamp and Ballast Retrofits					
LD-1: Delamp and Retrofit from 2-Lamp F40T12 Fixture to a 1-Lamp F32T8 Fixture with Electronic Ballast	31.0	20,000	$2.83	0.150	$0.380
LD-2: Delamp and Retrofit from 4-Lamp F40T12 Fixture to a 2-Lamp F32T8 Fixture with Electronic Ballast	61.0	20,000	$2.83	0.122	$0.335
Lighting Fixture Lamp and/or Ballast Retrofits					
LF-1: Retrofit LED Lamp Kit in Existing Exit Lights	1.8	220,000	$31.50	0.083	$0.155
LF-4B: Delamping & Reflector + Electronic Ballast and 2xF32T8 Lamps	61.0	20,000	$2.83	0.122	$0.335
LF-5: Replace lamp and base with DTT-26W, 2700K, CRI 80 Compact Fluorescent	35.0	10,000	$7.23	0.083	$0.987
LF-6: Replace lamp and base with DTT-26W, 2700K, CRI 80 Compact Fluorescent	35.0	10,000	$7.23	0.083	$0.987
LF-7: Retrofit with 50W HPS Lamp & Ballast	80.0	24,000	$23.95	0.300	$1.395
LF-8: Retrofit with 250W HPS Lamp & Ballast	300.0	24,000	$27.40	0.300	$1.539

Table 19. Lighting Energy Use Factors

Task Code	Description	Demand Factors per Building											
		117-1	117-2	117-3	117-4	117-5	117-6	117-6A	117-7	117-8	117-10	117-11	117-15
1	Corridors	0.8	NA	1.0	0.8	0.7	0.6	NA	NA	0.6	0.7	NA	NA
2	Kitchens	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	Dining	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	Offices - General & Classrooms	0.7	NA	0.7	0.9	NA	NA	NA	1.0	0.8	0.8	NA	NA
5	Conference	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6	Offices - Drafting	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7	Laundry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	Toilets / Locker Rooms	0.6	NA	0.6	0.6	0.6	0.6	NA	NA	0.6	0.6	NA	NA
9	Sleeping Quarters	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10	Supply Rooms	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11	Repair Shops	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	Storage Rooms	0.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13	Retail Stores	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14	Industrial Process	NA	0.6	0.8	1.0	1.0	1.0	0.6	0.6	1.0	1.0	0.4	0.8
15	Mechanical / Electrical Room	1.0	NA	1.0	1.0	0.8	0.8	NA	NA	0.8	0.8	NA	NA
16	Janitor's Closet	1.0	NA	1.0	1.0	1.0	1.0	NA	NA	1.0	1.0	NA	NA
17	Lounge / Break Room	1.0	NA	NA	NA	NA	0.8	NA	NA	NA	NA	NA	NA
18	Chemical Analysis Laboratory	1.0	NA	NA	NA	NA	0.7	NA	NA	NA	NA	NA	NA
Exit	Exit Lights	1.0	NA	1.0	1.0	1.0	1.0	NA	NA	1.0	1.0	NA	NA
Extr	Exterior Lighting	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	NA

Table 19. Lighting Energy Use Factors

Task Code	Description	Scheduled Hours/Week per Building											
		117-1	117-2	117-3	117-4	117-5	117-6	117-6A	117-7	117-8	117-10	117-11	117-15
1	Corridors	96.0	NA	96.0	96.0	96.0	96.0	NA	NA	96.0	96.0	NA	NA
2	Kitchens	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	Dining	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	Offices - General & Classrooms	96.0	NA	96.0	96.0	NA	NA	NA	168	96.0	96.0	NA	NA
5	Conference	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6	Offices - Drafting	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7	Laundry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	Toilets / Locker Rooms	96.0	NA	96.0	96.0	96.0	96.0	NA	NA	96.0	96.0	NA	NA
9	Sleeping Quarters	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10	Supply Rooms	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
11	Repair Shops	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
12	Storage Rooms	96.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
13	Retail Stores	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
14	Industrial Process	NA	24.0	96.0	96.0	96.0	96.0	96.0	168	96.0	96.0	96.0	96.0
15	Mechanical / Electrical Room	4.0	NA	24.0	24.0	96.0	96.0	NA	NA	96.0	96.0	NA	NA
16	Janitor's Closet	12.0	NA	8.0	8.0	12.0	12.0	NA	NA	12.0	12.0	NA	NA
17	Lounge / Break Room	96.0	NA	NA	NA	NA	96.0	NA	NA	NA	NA	NA	NA
18	Chemical Analysis Laboratory	96.0	NA	NA	NA	NA	96.0	NA	NA	NA	NA	NA	NA
Exit	Exit Lights	168	NA	168	168	168	168	NA	NA	168	168	NA	NA
Extr	Exterior Lighting	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	84.0	NA

Note: WADF facilities schedules varry depending on the work load. Assume 2 shifts per day, 6 days per week.

Table 20. Lighting Systems Legend

Task Code	Description
1	Corridors
2	Kitchens
3	Dining
4	Offices - General & Classrooms
5	Conference
6	Offices - Drafting
7	Laundry
8	Toilets / Locker Rooms
9	Sleeping Quarters
10	Supply Rooms
11	Repair Shops
12	Storage Rooms
13	Retail Stores
14	Industrial Process
15	Mechanical / Electrical Room
16	Janitor's Closet
17	Lounge / Break Room
18	Chemical Analysis Laboratory
Extr	Exterior Lighting
Exit	Exit Light

Fixture Type Code	Description
P	Pendant-Mounted Fixture
P-ExP	Pendant-Mounted Explosion Proof Fixture
P-Ind	Pendant-Mounted Industrial Fixture
R	Recessed Fixture
S	Surface-Mounted Fixture
S-ExP	Surface-Mounted Explosion Proof Fixture

Ceiling, Wall and Floor Colors

L	Light
M	Medium
D	Dark

Window Code

NA	Not Applicable

Lamp Type	Description
F32T8	Fluorescent Lamp, 48-inches long, 32 Watts, 1-inch diameter
F40T12	Fluorescent Lamp, 48-inches long, 40 Watts, 1-1/2-inch diameter
F40T12VH	Very High Output Fluorescent Lamp, 48-inches long, 110 Watts, 1-1/2-inch diameter
F, 6 Watt	Fluorescent Lamp for Exit Fixtures, 6 Watts
I	Incandescent Lamp
MV	Mercury Vapor Lamp
MH	Metal Halide Lamp

installation: HAWTHORNE ARMY AMMUNITION PLANT

project: ECIP FACILITY ENERGY IMPROVEMENTS

project number
temporary: _____ program year 1996

permanent: _____ category code 80000

point of contact:

user
name _____ date _____
title _____ phone _____
autovon _____

dfae
name _____ date _____
title _____ phone _____
autovon _____

engineer district
name _____ date _____
title _____ phone _____
autovon _____

other (A-E)
name _____ date _____
title _____ phone _____
autovon _____

reviewed by:

installation facility engineer
name _____ date _____
title _____ phone _____
autovon _____

approved by:

macom engineer
name _____ date _____
title _____ phone _____
autovon _____

project development brochure, PDB-1

DA FORM 5020-R, Feb 82

facility

ECIP FACILITY ENERGY IMPROVEMENTS HAWTHORNE ARMY AMMUNITION PLANT NEVADA

project coordinator for using service

FLOYD JUSTUS

PROJECT OBJECTIVE

The objective of the project is to reduce energy consumption and costs and to reduce operating costs by implementation of the following retrofits:

a. Replace steam condensate return systems in Buildings 117-1, 117-3, 117-4, 117-5, 117-6, 117-8 and 117-10.

b. Reduce steam pressure and install new deaerator at Central Boiler Plant 117-2. Repair leaks in distribution piping.

c. Install oxygen trim combustion controls and flue economizer on boiler in Bulding 117-2.

d. Install DDC retrofits on HVAC systems in Buildings 117-1, 117-3, 117-4, 117-5, 117-6, 177-8, 117-10 and 117-11.

e. Install air curtains on roll-up doors in Buildings 117-5 and 117-6.

f. Install exhaust air heat recovery run-around loops in Buildings 117-5 and 117-6.

g. Repair melt kettle and separation tank insulation in Buildings 117-5 and 117-6.

h. Replace existing compressors with a 250HP, two-stage rotary screw compressor in Building 117-2.

i. Install variable speed drive retrofits on high pressure water pumps in Building 117-6A.

j. Retrofit 369 existing fixtures with energy-efficient units in Buildings 117-1, 117-2, 117-3, 117-4, 117-5, 117-6, 117-6A, 117-7, 117-8, 117-10 and 117-11. Install LED retrofit kits in 81 exit signs in Buildings 117-1, 117-3, 117-4, 117-5, 117-6, 117-8 and 117-10.

A. SPECIAL CONSIDERATIONS

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
A-1	Cost estimates for each primary and supporting facility	R	D		
A-2	Telecommunications system coordination with USACC and authorization for exceptions	NR			
A-3	Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse ccoordination, etc.)	NR			
A-4	Assignment of airspace	NR			
A-5	Economic analysis of alternatives	NR		X	
A-6	Approval for new starts	NR			
A-7	International balance of payments (IBOP) coordination with U.S. European command and NATO—overseas cost estimates and comparables (include rate of exchange used in estimates)	NR			
A-8	Impact on historic places—on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation	NR			
A-9	Exceptions to established criteria	NR			
A-10	Coordination with various staff agencies (Provost Marshall-physical security, etc.)	NR			
A-11	Identification of related or support projects (so projects can be coordinated)	R	A		
A-12	Required completion date	R	A		
	Other Special Considerations (List and number items)				

Comment

A-5: Economic analysis provided in the Detailed Justification to DD Form 1391.

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED — Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED — Significant information summarized or explained and attached.

DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

*BY WHOM (Check and insert appropriate letter)

A — OFAE
B — Using Service
C — Construction Service
D — Designer
E — Other (Check Comments Attached and explain)

C. ARCHITECTURAL & STRUCTURAL

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
C-1	Reconciliation with troop housing programs and requirements	NR			
C-2	Evaluation of existing facilities (including degree of utilization)	NR			
C-3	Approval for removal and relocation of existing useable facilities	NR			
C-4	Evaluation of off-post community facilities	NR			
C-5	Storage and maintenance facilities (including nuclear weapons)	NR			
C-6	Coordination hospitals, medical and dental facilities with Surgeon General	NR			
C-7	Coordination of aviation facilities with FAA	NR			
C-8	Coordination air traffic control and navigational aids with USACC	NR			
C-9	Tabulation of types and numbers of aircraft	NR			
C-10	Evaluation of laboratory, research and development, and technical maintenance facilities	NR			
C-11	Coordination chapels with Chief of Chaplains	NR			
C-12	Review food service facilities by USATSA	NR			
C-13	Automated data processing system or equipment approvals—cost analysis when ADP and/or communication centers not co-located with related facilities	NR			
C-14	Coordination postal facilities with U.S. Postal Service Regional Director	NR			
C-15	Laundry and dry cleaning facilities coordination with ASD(I&L)	NR			
C-16	Tenant facilities coordination with installation where sited	NR			
C-17	Facilities for or exposed to explosions, toxic chemicals, or ammunition—review by DDESB (See also Item 8-4)	NR			
C-18	Analysis of deficiencies	NR			
C-19	Consideration of alternatives	NR			
C-20	Determination whether occupants will include physically handicapped or disabled persons	NR			
C-21	As-build drawings for alterations or additions	NR			
C-22	Availability of Standard Design or site adaptable designs	R	C		
	Other Architectural & Structural (List and number items)	NR			

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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E — Other (Check Comments Attached and explain)

documentation checklist

DA FORM 5023-C-R, Feb 82

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
D-1	Fuel considerations and cost comparison analysis	R	D		
D-2	Energy requirements appraisal (ERA)	R	D		
D-3	Conformance with DOD Energy Reduction requirements	R	D		
D-4	Evaluation of existing and/or proposed utility systems	NR			
	Other Mechanical and Utility Systems (List and number items)				

REQUIRED OR NOT REQUIRED – Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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C – Construction Service
D – Designer
E – Other (Check Comments Attached and explain)

documentation checklist

DA FORM 5023-D-R, Feb 82

A. SPECIAL CONSIDERATIONS

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
A-1	Factors of risk, restriction or unusual circumstance expected to increase costs beyond applicable area averages	NR			
A-2	Construction phasing requirements	R	A		
A-3	Functional support equipment (mechanical, electrical, structural, and security) to be built in	R	D		
A-4	Equipment in place and justification	NR			
A-5	Other equipment and furniture (O&MA, OPA) and costs	NR			
A-6	Special studies and tests (hazards analyses, compatibility testing, new technology testing, etc.)	NR			
A-7	Type of construction (permanent, temporary, semi-permanent)	NR			
A-8	Government furnished equipment (quantities, procurement time, availability and special handling and storage requirements). Funds used for procurement.	NR			
	Other special considerations (list and number items)				

REQUIRED OR NOT REQUIRED – Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED – Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED – Significant information summarized or explained and attached.

DOCUMENT ATTACHED – Significant information is in an existing document which is attached.

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C – Construction Service
D – Designer
E – Other (Check Comments Attached and explain)

technical data checklist

DA FORM 5024-A-R, Feb 82

C. ARCHITECTURAL & STRUCTURAL

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
C-1	Vibration-producing equipment requiring isolation	R	D		
C-2	Seismic zone and other design load criteria (typhoon, hurricane, earthquake loads, high or low loss potential)	R	D		
C-3	Protective shelter evaluation and resistant design criteria (conventional/nuclear blast and radiation, chemical/biological)	NR			
C-4	Unusual foundation requirements (pier, pile, caisson, deep foundations, mat, special treatment, permafrost areas, soil bearing)	NR			
C-5	Designation and strength of units to be accommodated	NR			
C-6	Requirements and data for special design projects	NR			
C-7	Unusual floor and roof loads (safes, equipment)	NR			
C-8	Security features (arms rooms, vaults, interior secure areas)	NR			
	Other Architectural & Structural (List and number items)				

REQUIRED OR NOT REQUIRED – Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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C – Construction Service
D – Designer
E – Other (Check Comments Attached and explain)

technical data checklist

DA FORM 5024-C-R, Feb 82

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

	ITEM	Required or Not Required	* To Be Determined	Comment Attached	Document Attached
D-1	Special mechanical requirements or considerations (elevator, crane, hoist, etc.)	NR			
D-2	Special peak usage periods and peak leveling techniques	NR			
D-3	Maintenance considerations (accessibility of equipment, compatibility with existing equipment)	R	B		
D-4	Plumbing—availability, general system type and characteristics (proposed and/or existing, incl. compressed air and gas)	NR			
D-5	Heating—availability, general system type and characteristics (proposed and/or existing)	R	B		
D-6	Ventilating, air condition/refrigeration—availability, general system type and characteristics (proposed and/or existing)	R	B		
D-7	Electrical—availability, general system type and characteristics incl. airfield lighting, communication, etc. (proposed and/or existing)	R	B		
D-8	Water supply/waste treatment—availability, general system type and characteristics (proposed and/or existing)	NR			
D-9	Energy requirements/fuel conversion (sources, availability, loads, types of fuel, etc.)	R	B		
D-10	Solar energy evaluation	NR			
	Other Mechanical & Utility Systems (List and number items)				
D-11	Central plant compressed air system as built data	R	B		
D-12	High pressure water pump system as-built data	R	B		
D-13	Steam distribution system as-built data	R	B		

REQUIRED OR NOT REQUIRED – Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED – Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED – Significant information summarized or explained and attached.

DOCUMENT ATTACHED – Significant information is in an existing document which is attached.

*BY WHOM (Check and insert appropriate letter)

A – DFAE
B – Using Service
C – Construction Service
D – Designer
E – Other (Check Comments Attached and explain)

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